e!Sankey

v3.1

User Manual

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1 Introduction

e!Sankey is a software tool that helps you draw so-called Sankey diagrams.

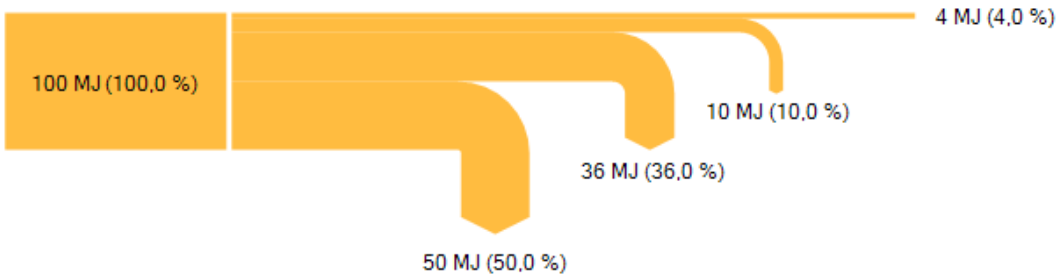


Figure 1: A simple Sankey diagram

Sankey diagrams are directed graphs, where the magnitude of the arrow line represents the quantity of flow. Today, Sankey diagrams are used for a variety of flow visualizations. These are not limited to energy or material, but indeed to any (real or virtual) matter that flows "from" a source "to" a destination.

"Sankey diagrams are a specific type of flow diagram, in which the width of the arrows is shown proportionally to the flow quantity. They are typically used to visualize energy or material transfers between processes." (Wikipedia)

Sankey diagram visualizations draw the viewers attention to the largest flows, while at the same time showing the proportions of the flows among each other and indicating a "from-to" flow direction. In that sense they convey efficiency of transformation processes and also allow to assess the balance of input/output streams.

Sankey diagrams are named after Captain Matthew Henry Phineas Riall Sankey, an Irish engineer (1853-1925).

The software e!Sankey is a member of the Umberto software[1] family. While e!Sankey simply allows drawing Sankey diagrams, the Umberto software tools are fully-fledged modelling tools where material, energy and cost flows are determined based on process specifications. The Sankey diagrams in Umberto are one of the display options to visualize the calculated flows and environmental impacts.

We hope you enjoy working with e!Sankey!

[1] http://www.umberto.de

Further Reading on Sankey Diagrams

Schmidt, Mario (2006) Der Einsatz von Sankey-Diagrammen im Stoffstrom-management. Beiträge der Hochschule Pforzheim Nr. 124 (in German)

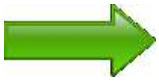
Schmidt, Mario (2008) The Sankey Diagram in Energy and Material Flow Management. Part I: History. Journal of Industrial Ecology 12 (1), 82–94

Schmidt, Mario (2008) The Sankey Diagram in Energy and Material Flow Management. Part II: Methodology and Current Applications. Journal of Industrial Ecology 12 (2), 173–185

Links

http://en.wikipedia.org/wiki/Sankey_diagram
http://www.sankey-diagrams.com
http://www.e-sankey.com

A hint or additional advice.



Cross-reference to a related topic within the user manual or in the e!Sankey Tutorial.

2 Installation

Administrator rights are required to install e!Sankey on your computer. Contact your administrator, if you only have limited rights on your machine.

System Requirements
To install and run e!Sankey the following requirements have to be met:

- Operating system Windows XP, Windows Vista, Windows 7 or Windows 8
- Microsoft .NET Framework 3.5 SP1[2]
- Memory 1 GB RAM or higher
- Available hard disk space: at least 100 MB
- Monitor with at least 1280 x 1024 px resolution (recommended)

A monitor with a screen resolution of at least 1280 x 1024 pixels or higher is recommended, to be able to handle several windows of the application being visible side-by-side. The software can be run in a multi-screen modus.

Running the Installer File
Run the installer file by clicking on the downloaded executable (the file is named 'esankey.exe'). You need administrator rights on your local machine for the installation.

If an older version of e!Sankey is found, the installation routine will offer to uninstall the older version prior to continuing the installation of the new version.

You will be asked to accept the e!Sankey End User License Agreement (EULA). Please confirm that you have read and agree to the EULA by checking the confirmation box.

By default, the installation directory for the application is "c:\Program Files (x86)\ifu Hamburg GmbH\e!Sankey". You may of course opt to choose to install to a different directory by clicking on the 'Change…' button.

One additional folder "e!Sankey" is installed as data subfolder of "c:\My Documents". It is used to store the template files (file extension '.santem'), example files (file extension '.sankey') and clipart files.

Trial Version
When starting up e!Sankey a licensing dialog box will be prompted. If you have already purchased a license, you can enter the key to register your version.

If you don't enter license key, you can run e!Sankey as a trial version for 14 days from installation. The trial version almost has the same functionality as the full version, but the following limitations:

- watermark over the Sankey diagram in the editor
- no export in EMF format

The trial version prompts for a registration key on start-up.

To get a licensed version of e!Sankey, you can purchase a license key from our online shop at http://www.e-sankey.com.

[2] The existence of the Microsoft .NET Framework 3.5 SP1 will be checked during installation, and if it is not available, you will be asked to install it first, before proceeding with the installation. It can be downloaded from the Microsoft web page.

Updates
When new versions of e!Sankey are released, a notification on the start page will indicate the availability of an update. Click on the link shown to access a web page where you can download the new version.
You can also use the command 'Check for Updates…' from the Help menu, to find out whether an update is available.

Please note that both, the automatic update notifier, as well as the check for updates feature might not work, if you don't have access to the Internet, or if security settings of your firewall prohibit communication with the update server. In this case, please check the community board for announcements regularly, and contact ifu Hamburg GmbH for a new version to be sent.

The update notification service can be deactivated in the Options dialog accessible via the Tools menu.

Support
The help system (Menu Help > Index, or press F1 on the keyboard) is always the first option when you have a question on the software. It describes the functions available, but also contains hints on the use of e!Sankey, and on modelling the product life cycle.

For technical support issues the e!Sankey help desk can be reached by e-mail at support@e-sankey.com

In your support request please indicate the exact version number (see About dialog) of e!Sankey you are using, and the operating system of your computer. Please try to be as specific as possible when explaining the technical problem that occurred.

In some cases our help desk will ask you to submit log files from your computer, which can help us identify the issue. The log files can be found at the following default location (localized operating systems might have different folder names):
XP:
C:\Documents and Settings\[user]\ Application Data\Ifu Hamburg GmbH, Germany\e!Sankey\3.1\log\
Vista/Win7:
C:\Users\[user]\AppData\Roaming\Ifu Hamburg GmbH, Germany\e!Sankey\3.1\log

The log file is called "general.txt" and should be submitted with your technical support inquiry to our help desk. It can be viewed with a simple text editor.

A community forum (bulletin board) is available at http://http://forum.e-sankey.com. It contains useful tips and tricks, and also has a FAQ (frequently asked questions) section. You can browse the posts of other users of e!Sankey and discuss with them.

Uninstalling
To uninstall e!Sankey from your computer, run the de-installation from the command in the Start menu group. Alternatively, you may want to remove the software via the Control Panel > Add/Remove Programs.

A deinstallation of the product is proposed when running the installation of a newer version of the software. Please uninstall prior to installing a new version.

3 General Functions of e!Sankey

Screen Layout and Windows Handling

The main working area of the e!Sankey application has several panels and areas. In the default layout, they look more or less like this:

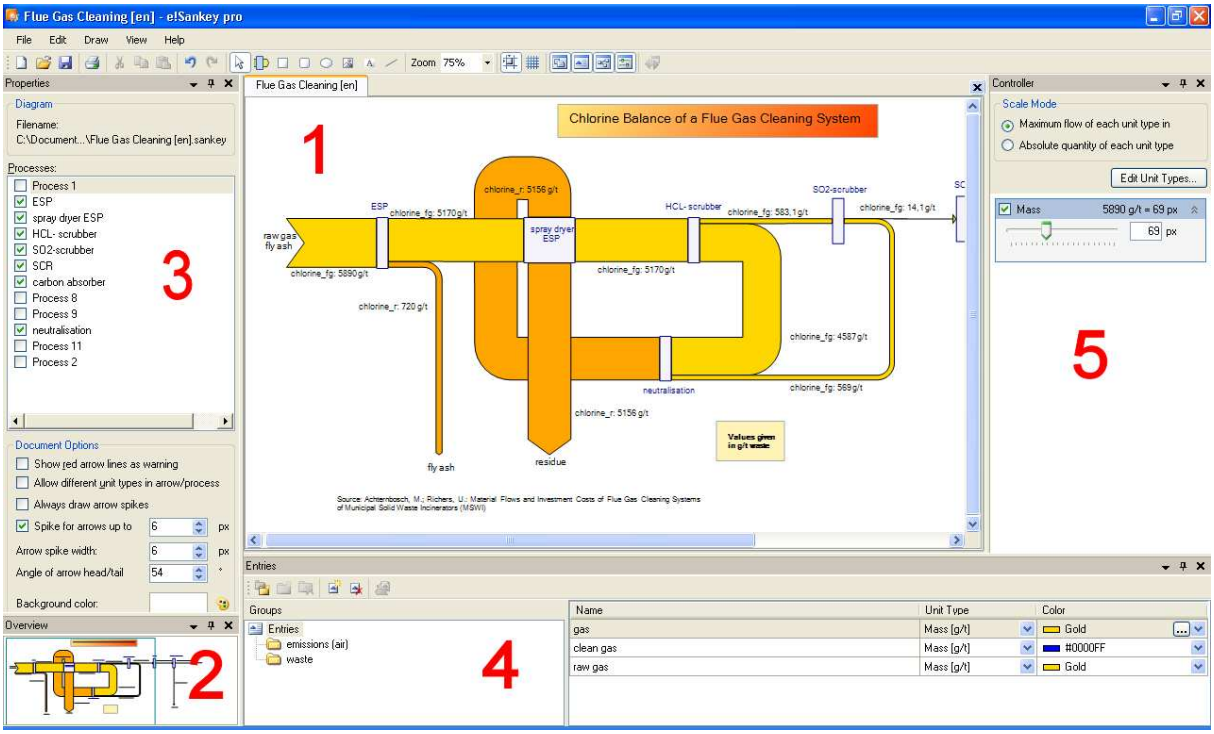


Figure 2: e!Sankey default screen layout, window panes are numbered

The main window panes are:

- **Drawing area** (several diagrams can be opened at once) **(1)**
- **Overview**: shows a miniature view of the Sankey diagram **(2)**
- **Properties:** allows to edit the properties of the network element marked in the drawing area **(3)**
- **Entries:** list of material, energy, or the like that are used as flows in the arrows of the Sankey diagram **(4)**
- **Controller:** allows to scale the flows in the diagram separately for each unit type, edit unit types **(5)**

The latter four window panes can be hidden and shown using the 'Show' buttons in the toolbar at the top. Window panes can be adapted and arranged, so that the user can customize the screen layout to his/her individual requirements and working style.

Moving Windows: You can move a window pane wherever you want it by clicking the blue title bar and dragging the window where you want it.

Floating Windows: If you drop the window pane at a random location in the program window, it becomes a 'floating' window.

Docking Windows: Docking a window means to attach it to the edge of the program window. This allows you to reposition the various tool windows such as the 'Entries', the 'Properties' or the 'Controller' to dock against different application edges. To do

this, move the floating window pane by clicking in the title bar of the window pane, drag it to the edge where you want to dock it, and drop it onto one of the blue arrows that appears near the edges of the program window. To be able to dock a window, make sure the dockable Windows command is activated in the View menu.

Figure 3: Docking icons (center, dock left, dock top, dock right, dock bottom)

Hide Window Panes: To hide window panes completely, unmark the respective entry in the View menu. To make a hidden pane visible again, set the tick mark in front of the menu entry.

Auto Hiding Windows / Tabbed Windows: In the top-right corner of every window pane, you will see a small button that looks like a pin. If you click this button, the window pane is hidden (or "pinned" to the edge of the program window). However, you can still see the title of the window pane along the edge of the program window. When hovering the mouse over the title, the window pane temporarily displays again until you move the mouse off the window pane. Click the button again to "un-pin" the window pane.

Reset Panes: To reset the window panes to the default setting (Properties and Overview docked on the left, Entries docked at the bottom, and Controller docked at the right) just select the Reset command from the View menu.

User Interface Language: The user interface language of e!Sankey can be switched to English, German, French, Spanish and Portuguese. Access the Options dialog via the Edit menu. On the General tab choose the new language. A restart of the application is required for the change to take effect.

Undo/Redo: e!Sankey has an Undo and Redo functionality for almost all actions performed by the user in the course of a work session with the software.

Undo: To undo (revert) an action that has been done in the software, click on the button 'Undo' in the main toolbar or use the menu entry 'Undo' in the Edit menu. The hint of the button and the menu entry show the last action performed that will be undone. Alternatively use the keyboard shortcut CTRL-Z.

Several multiple actions can be reverted (undone) by repeating this action.

Redo: To redo (revert undo) an action that has been undone, click on the button 'Redo' or use the menu entry 'Redo' in the Edit menu. The bubble hint of the button and the menu entry show the last action performed that has been undone and that will be reverted. Alternatively use the keyboard shortcut CTRL-Y.

4 Getting Started: The Basics

Create a Diagram File

To create a new diagram file, click on the button 'New Document' in the toolbar. Alternatively select 'New' from the File menu and choose one of the predefined templates. Or, click on one of the templates listed in the "Templates" section on the left side of the start screen.

Templates have entries, units, preferences settings and color pallets predefined. You will learn more about templates later.

To save a diagram file, click on the 'Save Document' button in the toolbar, or choose 'Save As…' from the file menu. You will be asked to enter a name. e!Sankey diagram files have the file suffix ".sankey".

Three Basic Steps: Drawing Process and Arrows, Entering Flows

In this section you will learn how to draw Sankey diagrams in e!Sankey. Sankey diagrams consist of processes (also referred to as "nodes") and arrow lines between the processes. Flows are entered in the flows with their quantities and represented with the arrow width proportional to the magnitude of the flow.

Even if the process boxes are not visible (hidden) in the diagram, they must first be drawn, in order to be able to connect an arrow to them.

1 - Draw Process: To draw a process, click on the button 'Process' in the toolbar, then click in the drawing area where you wish to place the process (node).

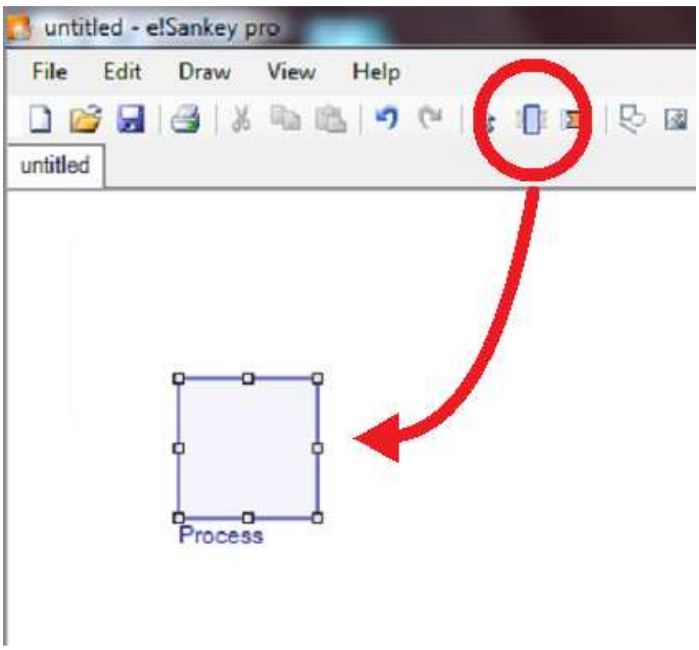


Figure 4: Selecting the Process button and positioning a process symbol in the editor

You can continue to insert processes when in the insert mode until you choose another command (or click ESC or click the right mouse button to end the insert mode)

After setting two or more processes, you can connect these process nodes with arrows, as follows:

2 - Draw Arrow: Move the cursor to the centre of the process symbol (start node). The process will become filled gray and the cursor symbol turns into a hand. Click with the left mouse button, keep it pressed, then drag to the other process (destination node). When over the centre of the process symbol, this square will be filled gray too. The mouse button can be released now. The arrow will snap to the process. It will also connect to the process, if you only drag it very close to the destination process - almost like a magnet.

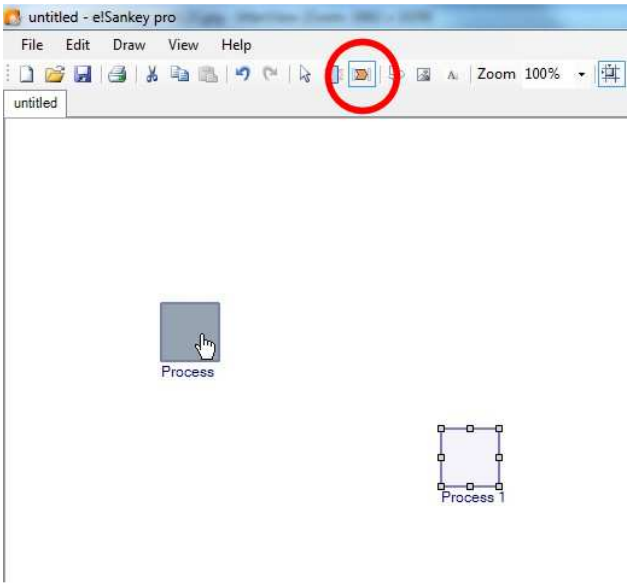


Figure 5: Two processes are linked with an arrow. In the insert arrow mode a process will be shown filled when the mouse cursor is neared. Press the mouse-button…

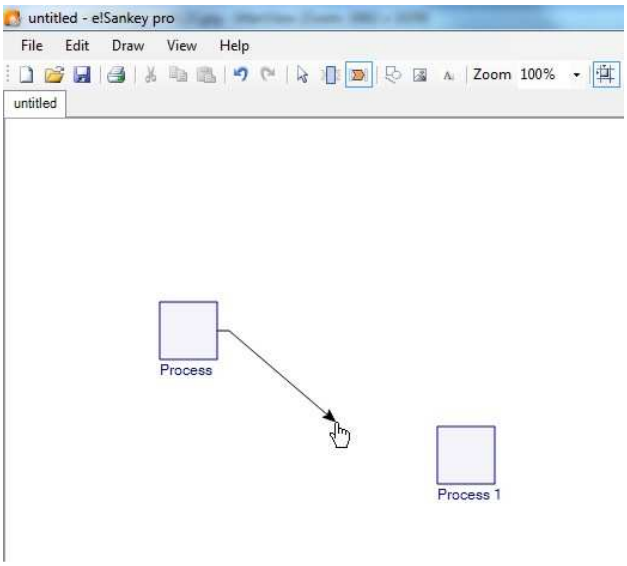


Figure 6: …keep it pressed and drag towards the destination process…

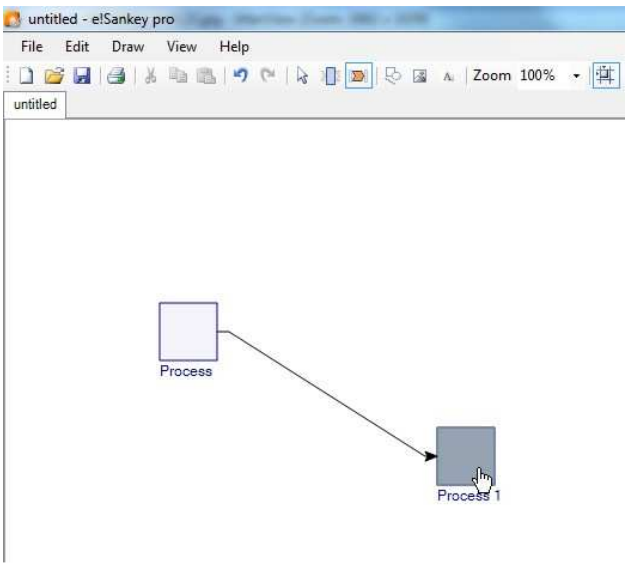


Figure 7: …the destination process will be shown filled when the mouse cursor is moved over it. This signals that the arrow will snap to that process. Release the mouse button.

The arrow at that stage is empty. This is indicated with the hint "<No Flows>". The arrow shows two yellow marker points and two red points where it connects to the processes. You will learn more how to use these points later.

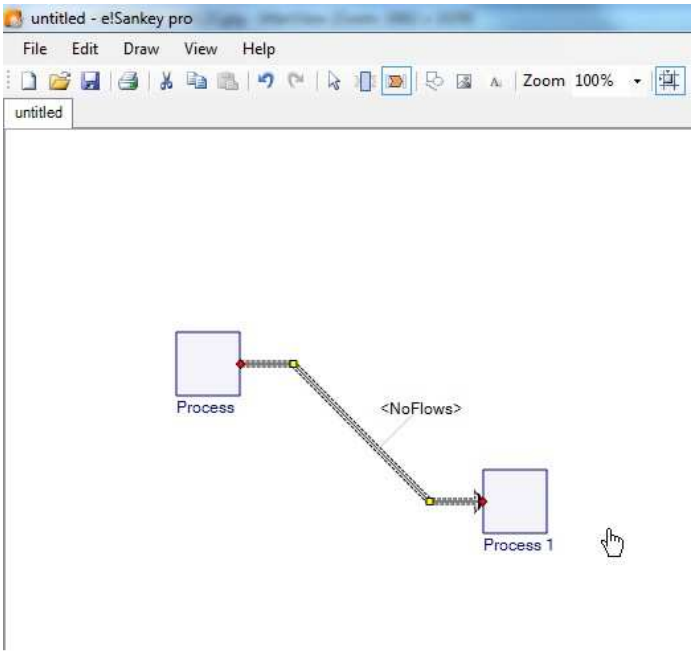


Figure 8: An arrow has been drawn, but it contains no flows at this stage.

Finally, you have to define what flows along the arrows from one process to the next. This can be material, products, heat or any other form of energy, persons, money … These items can be defined in the 'Entries' window.

3 - Enter Flow in Arrow: Use the pre-defined sample items in the 'Entries' window. Drag the entry "water" onto the arrow. The Arrow Property dialog will come to front (make sure the Property pane is visible and docked), and the entry water will appear in the flow list. You can directly enter a quantity in the "Quantity" column of the flow entry. When you click return, the arrow line between the two processes is shown at a width, representing 300 kg of water.

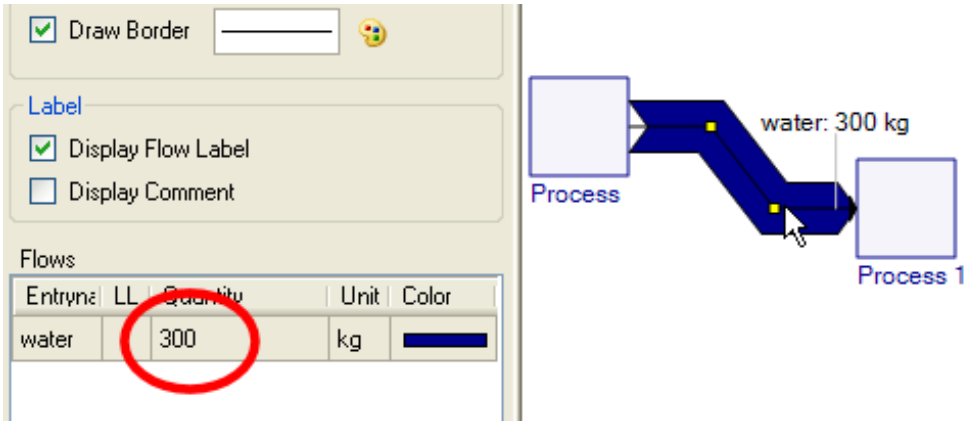


Figure 9: Entering a quantity value for the entry that has been dragged onto the arrow

These three steps are essentially what you need to know to create a Sankey diagram. In the next chapters, you will learn how to use the many option settings and individual properties of the diagram elements, to improve the layout and design of your Sankey diagram.

Useful Hints for Drawing Sankey Diagrams

There is also an advanced drawing mode, where you don't have to set process nodes before you connect them with arrows. After activating the Arrow mode, simply drag the mouse cursor on an empty area in the diagram. You can also start an arrow on an existing process node and draw the arrow "into the void". When the mouse cursor is released a process and an arrow that connects to it is drawn.

'Copy & Paste' can be used to copy diagram sections. You can copy diagram sections between different diagram files (Hint: open several files in tabbed editor areas), but mind that the flows in the copied file might have different unit types and colors in the other diagram file. There is no automatic unit conversion. Scaling might be required after copying and pasting between diagrams.

To mark several elements of the diagram, drag a marking frame around them with the mouse button pressed. Mark the whole diagram with all elements using CTRL+A. Move the selected elements of the diagram with the mouse or the cursor keys or edit several element properties at once. For editing the properties of multiple elements, choose the element type from the dropdown list 'Edit Type'.

Alternatively use 'Set As Default' from the context menu of an element (e.g. arrow, process, …) and mark the settings of the current element as the preferred one for this element type When inserting a new element of this type the settings will be used. This requires however, that you have a vision of how the arrows and processes should look like at an early stage of designing your diagram.

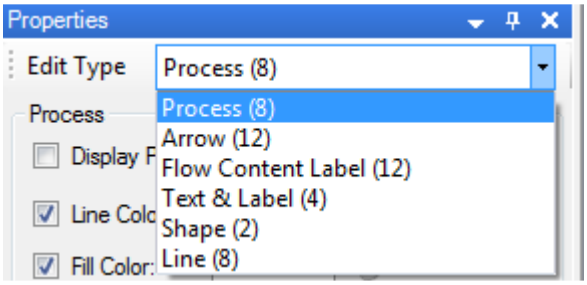


Figure 10: Multiple element editing in properties dialog

5 Arrows

Properties of Arrows

Arrows are the most important elements in a Sankey diagram. They always run between two process symbols, and are directed from a source (starting node) to a target (destination node). Arrows can take up flows from the Entries list. The quantities of the flows are represented by the width of the arrow. Several flows can run in one arrow (multi-flow arrow).

Click on an arrow to mark it, and the arrow properties dialog will be shown in the property pane.

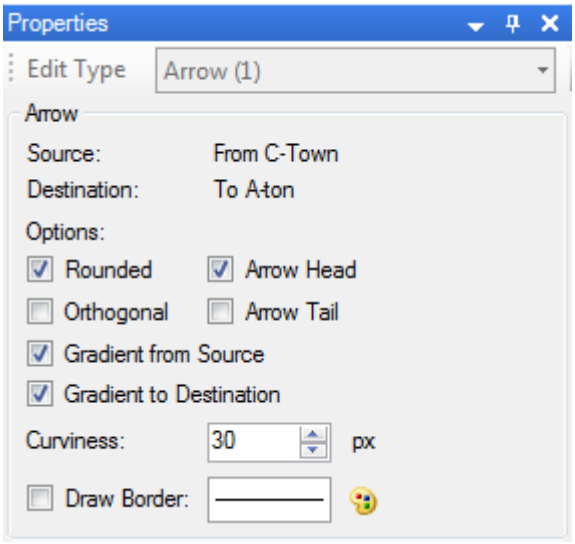


Figure 11: Arrow Properties

The 'Edit Type' dropdown list at the top of the Properties dialog allows editing the properties of several selected element of this type. The number in brackets shows the number of elements selected and affected by the changes. In the image above, only one arrow is selected.

The two options 'Rounded' and 'Orthogonal' refer to the way bent arrows are drawn.

The options 'Arrow Head' and 'Arrow Tail' can be used to individually turn on or off the base (tail) or the head of each arrow. Curviness is the measure for the radius of an arrow bent. The default setting is 30° degrees

Use 'Draw Border' to determine, whether an arrow should have a border line. Click on Select Color to set the border line color, width and style.

The options in the "Label" section allow showing or hiding flow labels, as well as the arrow comment line. While the arrow label is created automatically and made up by flow name, quantity and unit, the arrow comment line can be entered by the user individually.

Adapting Arrow Design

Arrows can be shown with different layout options. Check the possibilities in the property dialog. Below are some of the options:

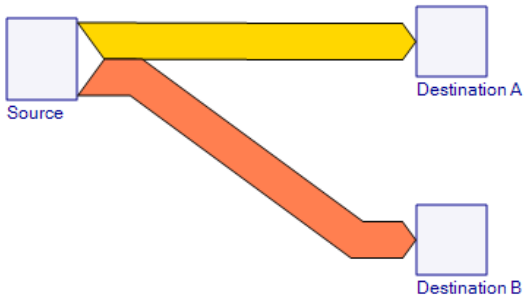


Figure 12-A: Arrow Head/Tail

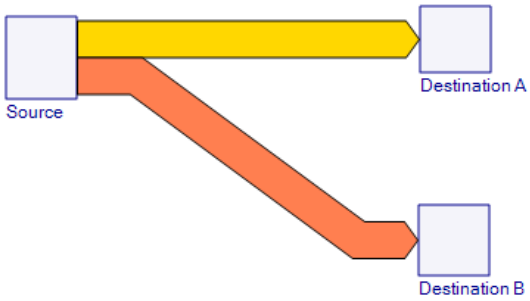


Figure 13: No Spiked Arrow Head

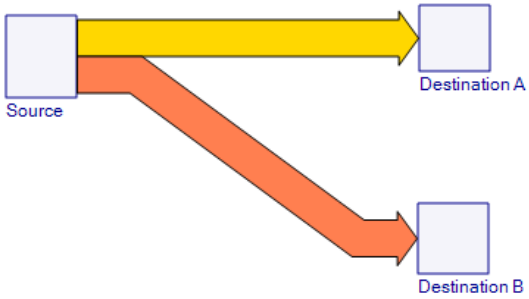


Figure 14: Explicit Arrow Head (Spikes)

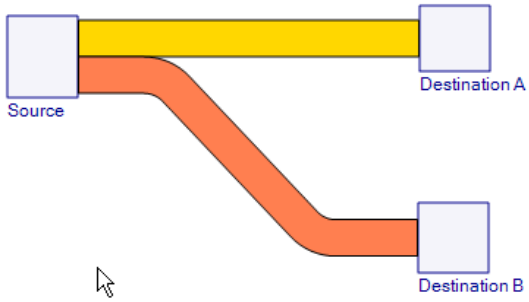


Figure 15: Arrow Heads Off (No Head)

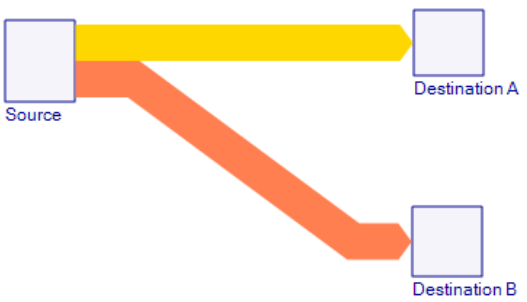


Figure 16: Without Arrow Border Line

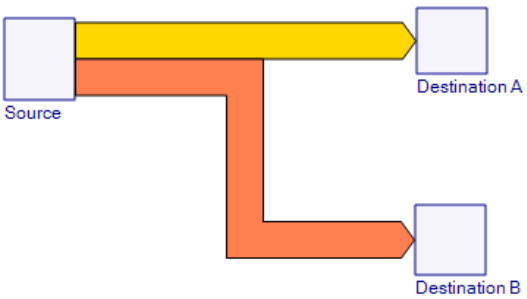


Figure 17: Orthogonal Arrow Routing

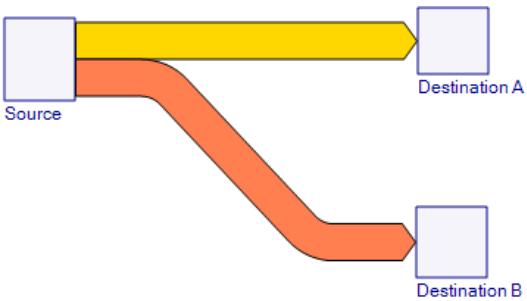


Figure 18: Rounded Arrow Bends

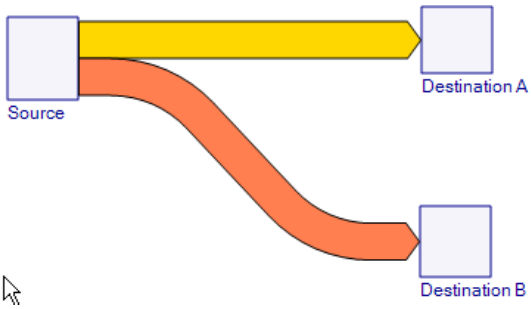


Figure 19: High Curviness (90)

These are just some of the possibilities you have for changing the arrow appearance. Settings are made for arrows individually or by using multiple edit for selected arrows.

Hint: Use 'Set As Default' from the context menu of the file to remember the settings for the next arrows you will be drawing in the diagram.

Color Gradient on Arrow: Using the options "Gradient from Source" and/or "Gradient to Destination" it is possible to replace the default color setting for a Sankey arrow, as defined in the "Entries" window for a material (see below). As a result the arrow will feature a color gradient from one color to another. The start color is defined by the color of the process and has to be set individually for each process in the Process Properties.

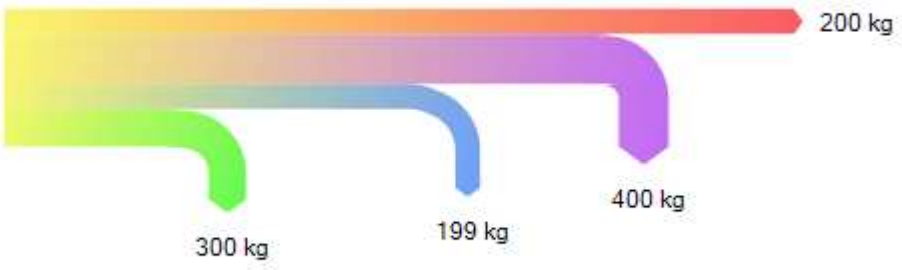


Figure 20: Stacked arrow with color gradients (source and destination processes are hidden)

Arrow Spikes: In some cases it might be useful to emphasize very thin Sankey arrows, by showing an arrow spike at the head.

This is a setting for the whole diagram, so it can be found in the property panel for the diagram, which appears when clicking on an empty area in the editor. In the "Document Options" pane at the bottom, the following options are available:

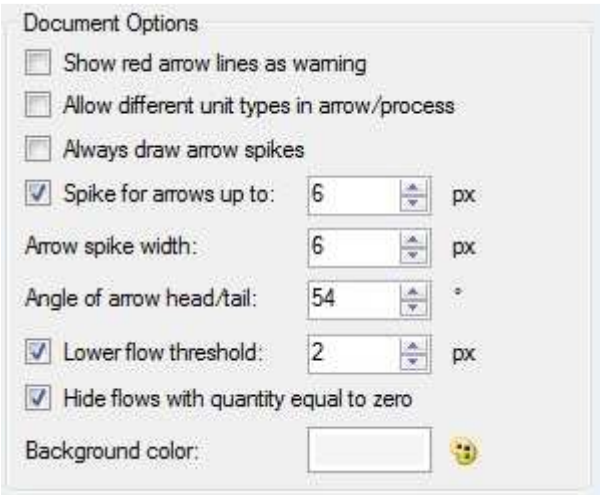

Document Options
Show red arrow lines as warning
Allow different unit types in arrow/process
Always draw arrow spikes
Spike for arrows up to: 6 px
Arrow spike width: 6 px
Angle of arrow head/tail: 54 °
Lower flow threshold: 2 px
Hide flows with quantity equal to zero
Background color:

Figure 21: Document options in Diagram Properties dialog

Set the option 'Always draw arrow spikes' in order to have all arrows, independent of the arrow width showing a spike. Alternatively use 'Spike for arrows up to:' and only thin arrows which have a width up to the chosen value will get a spike.

Use the "Arrow spike width setting" to determine the base of the spikes. Use the "Angle of arrow head/tail" to set the spike angle. Here are some examples:

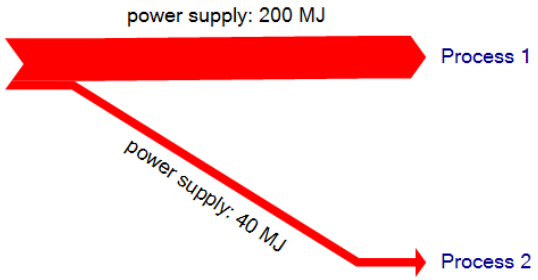


Figure 22: Arrow spike for small arrows only

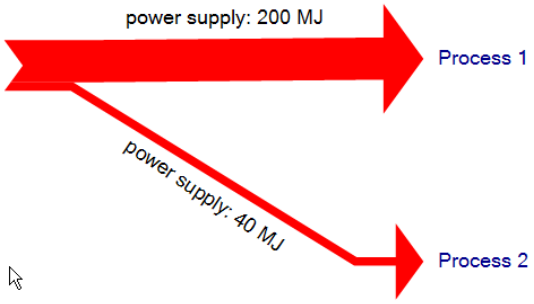


Figure 23: High spike width

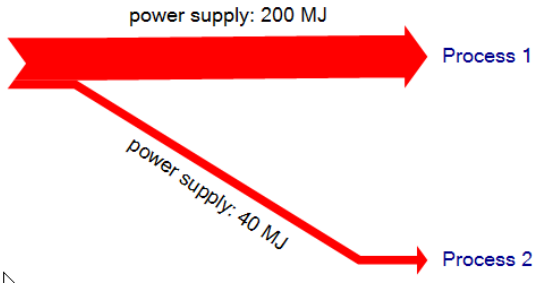


Figure 24: Always with arrow spikes

Please note that the flow values remain unchanged. Just by changing the arrow head (spike) settings, the impression the Sankey diagram conveys is quite different. It is recommended not to overemphasize small quantities using large arrow heads.

Flow Content Labels and Comments

Flow content labels are created automatically when inserting a flow into an arrow and entering its quantity. They are placed at a default position near the middle of the arrow route. The arrow label can be dragged around and positioned where it fits best.

Click on a flow content label and the properties dialog will be shown in the property pane. The entry in the 'Edit Type' dropdown list shows the number of flow content labels that are selected and that will be affected by property changes.

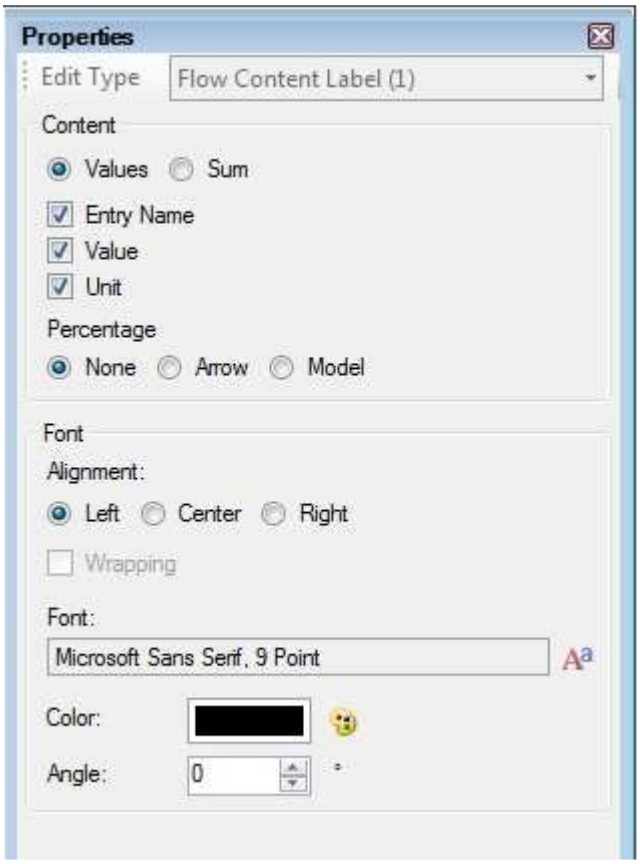


Figure 25: Flow Content Label Properties

The default display option for the arrow label is set to "Values", so that the flow quantities are shown. "Sum" refers to multi flow arrows (several flows in one arrow), and forces the sum of the flows with the same unit type to be displayed.

Flow content labels are made up from the flow name, the quantity and the unit. They cannot be edited directly, but name, quantity and unit can be turned on and off individually. Remove the tick mark for the respective time.

The 'Percentage' option is explained later in this tutorial.

The 'Alignment' and 'Font Style' can be edited in the "Font" pane.

Note: To hide a flow content label, remove the check mark in front of the "Display Flow Label" option in the arrow (!) property dialog.

Additionally to the flow content label, created automatically, an arrow comment label can be created, where free text can be entered, e.g. for comments etc.

Multi flow arrows are arrows that contain more than one flow entry. For multi flow arrows, the arrow label can be switched from individual "Values" to the "Sum" of all flows. If the flows are all in one group and have the same unit type, then the name of the group will be displayed along with the sum value. If flows are located in different entry groups, then the word "Sum" will be shown instead.

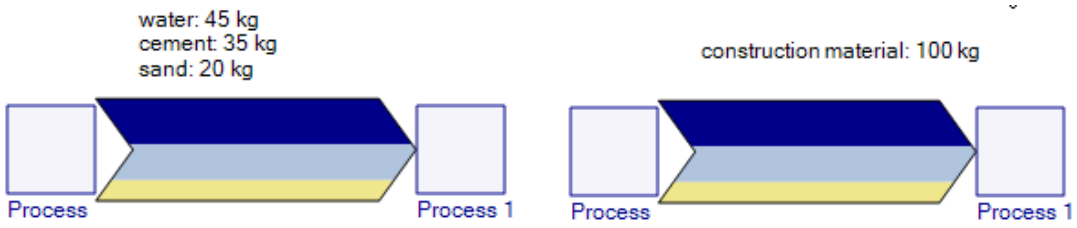


Figure 26: Multi flow with detailed arrow label and with "Sum" arrow label

The sort order in Multi Flow arrows can be adapted using the Move Up / Move Down buttons in the Arrow Properties dialog.

Hint: Use 'Set As Default' from the context menu of the file to remember the settings for the next arrows labels.

Both arrow labels as well as arrow comment labels can be rotated, e.g. to be able to place the label parallel to an arrow route.

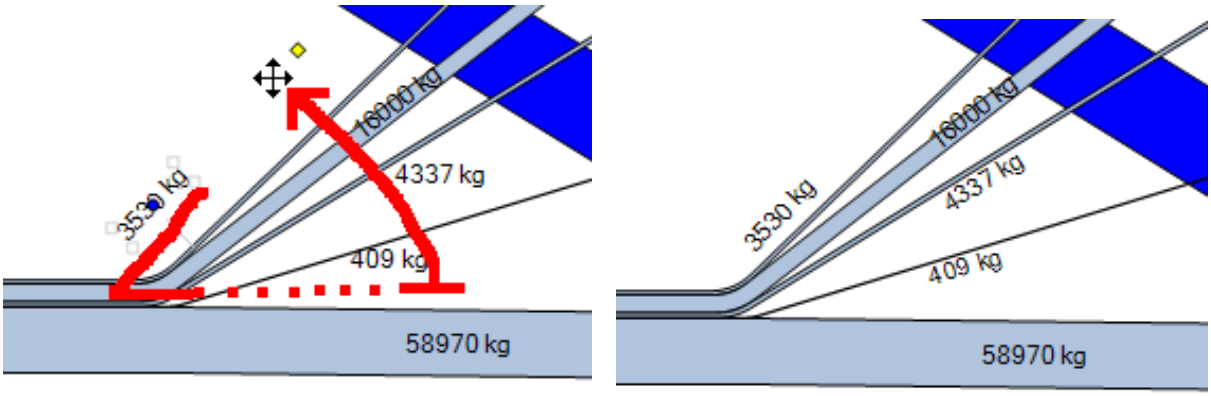


Figure 27: Arrow Label is rotated around an axis by dragging the yellow turning point. Arrow labels can be positioned to align with the direction of the arrow.

Arrow Routing

The routing of an arrow between two process nodes is done automatically. The arrow line has certain arrow points that determine the route. Further points can be added. These points become visible when the arrow is clicked. Additionally the connectivity behavior at the process can be set, which also influences the arrow routing.

The yellow points (lug points or hook points) are created by default at the end of the first segment after at a horizontal or vertical offset from the process node, and at the beginning of the last segment of an arrow that is linked to the process node. These yellow points can only be moved horizontally or vertically, depending on the orientation of the base segment or head segment of the arrow to the process node. They cannot be removed.

The red points are shown at the head and at the foot (tail) of the arrow where it connects to the process. These points can be used to disconnect the arrow from the process and reconnect it to another process.

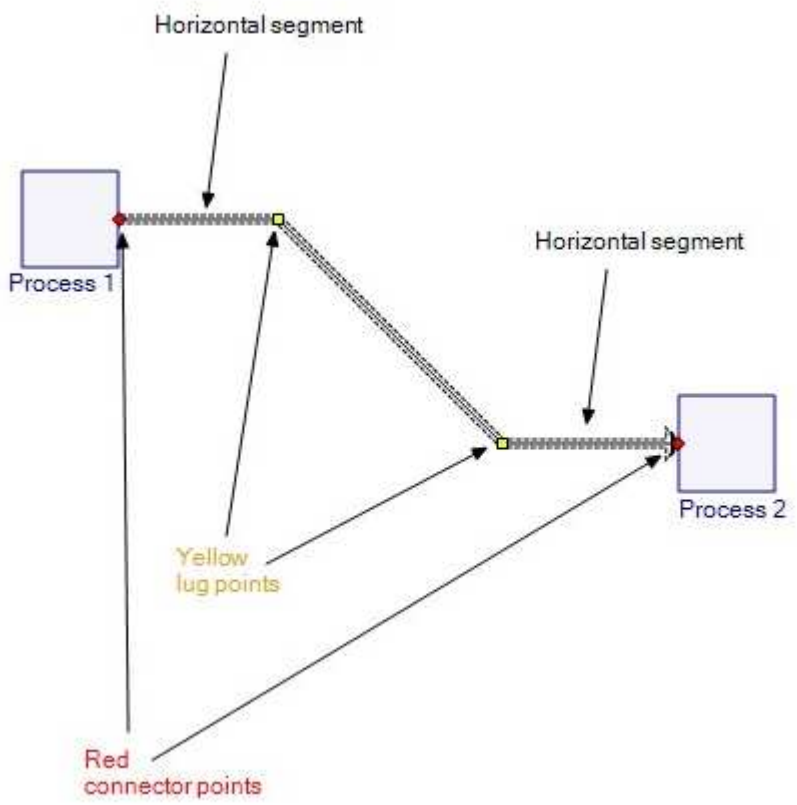


Figure 28: Yellow lug points and red connector points

On the arrow segment between the yellow points any number of grey bending points (routing waypoints) can be added. These grey points can be moved in the X- and Y-direction, and can be used to give an arrow routing that suits the requirements best.

Right mouse-click on the arrow segment on which you wish to add a bending point. Then choose 'Add Point' from the context menu. Drag the grey point to the desired place. Note that grey arrow waypoints cannot be inserted on the first and last (horizontal or vertical) segment, where the arrow connects to the process.

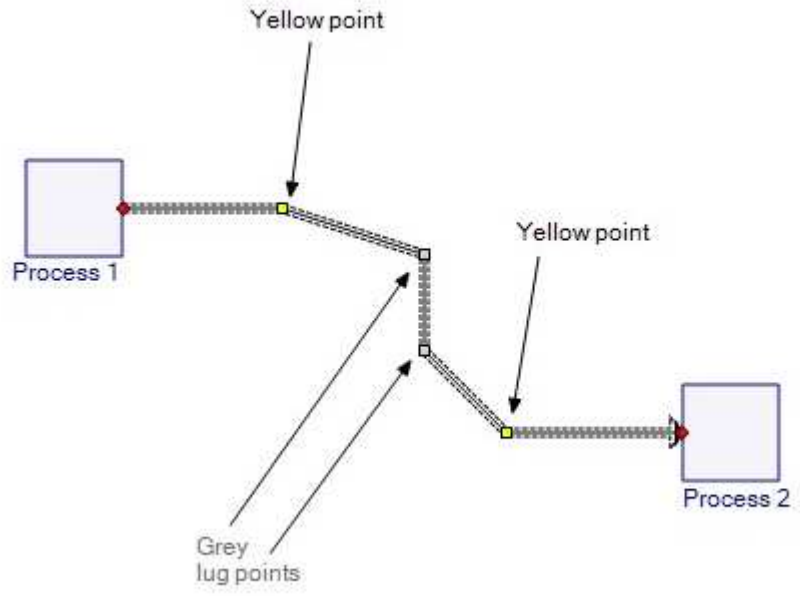


Figure 29: Grey bending points on the arrow segment between the yellow lug points.

Connectivity: The way an arrow connects to a process node depends on the connectivity setting in the process property dialog. The default setting is "Free", i.e. the connection direction is not restricted to a certain mode, but will be determined automatically depending on the angle of an imaginary line between process nodes. Thus the arrow offset will 'jump' to the other side of a process node when you move the process connected to it on the other end of the arrow to another position, where this imaginary line is above or below a 45° angle.

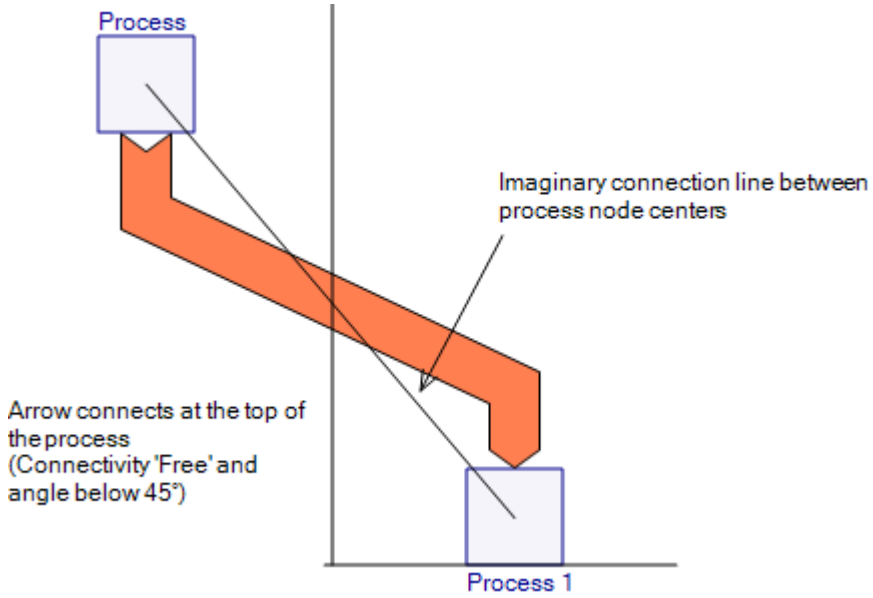

Process
Imaginary connection line between process node centers
Arrow connects at the top of the process (Connectivity 'Free' and angle below 45°)
Process 1

Figure 30: Automatic routing and connectivity depends on the angle between the imaginary connection line between the process symbol centres and a vertical line. Arrow connects at top.

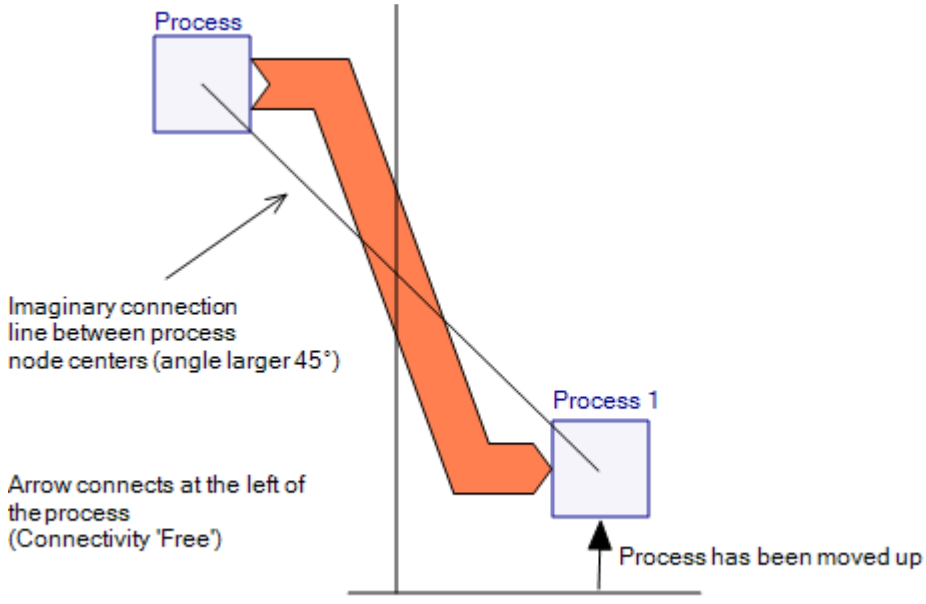

Process
Imaginary connection line between process node centers (angle larger 45°)
Process 1
Arrow connects at the left of the process (Connectivity 'Free')
Process has been moved up

Figure 31: The angle between the imaginary connection line between the process symbol centres and a vertical line exceeds 45° the arrow connection "flips" to the side..

If you want to force the arrow to connect to a specific side of a process, set the connectivity in the process property dialog to one of the following options: Left-To-Right, Right-to Left, Top-To-Bottom, Bottom-To-Top. The automatic connection direction as shown above will be overruled.

Z-Order: In stacked arrows (arrow sections where several arrows join to form one arrow head, or, one common arrow base), the automatic algorithm using the angle of the imaginary line between the process centres might lead to a wrong sorting order in the stacked arrow segment.

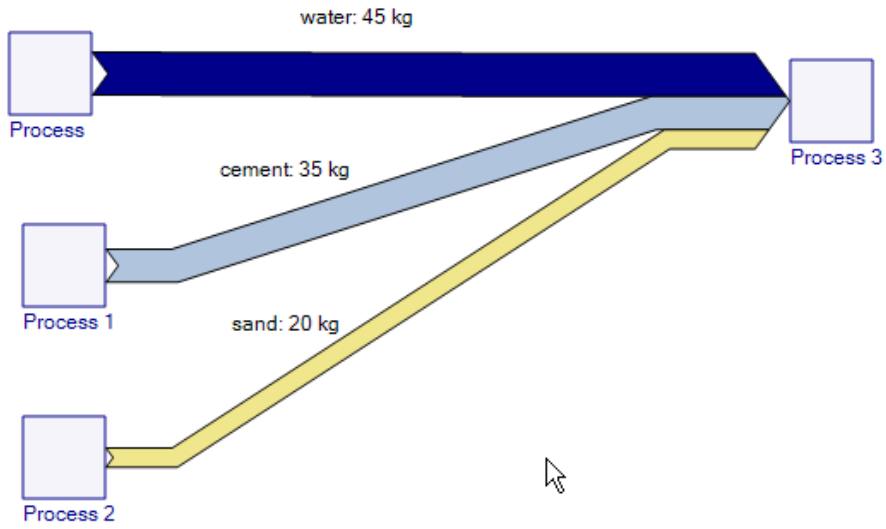


Figure 32: Process 2 (light sand color) is at the bottom

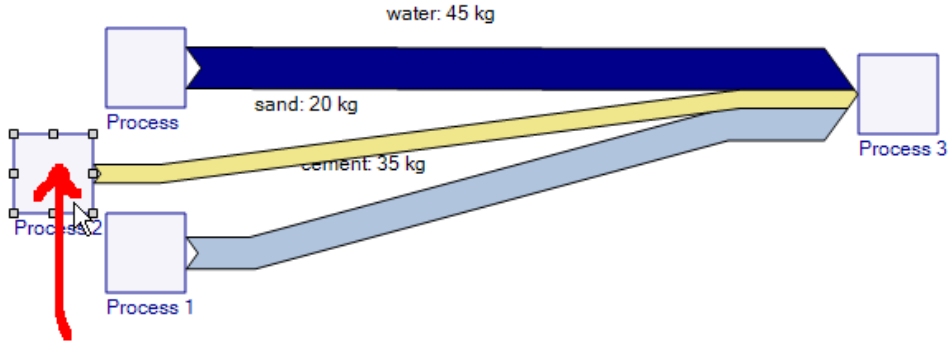


Figure 33: Process 2 (light sand color) is moved up to the middle…

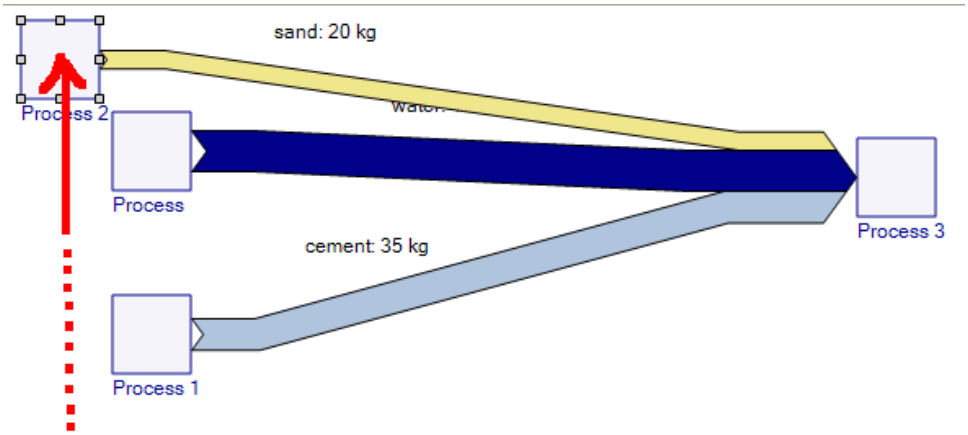


Figure 34: … then to the top the order in the stacked arrow segment is sorted accordingly (option "Sort by Angle")

In case such automatic sorting is undesired, click on the process where the stacked arrow segment connects (here: Process 3) and switch to "By Z-Order" in the Stacking option. In this case the automatic stacking by angle will be superseded.

The Z-Order of arrows (the layer on the drawing area) can be influenced with the command 'Bring Forward' or 'Send Backward' from the context menu of an arrow.

Using 'Bring To Front' brings the selected arrow all the way to the front, while 'Send to Back' sends it to the last layer of the diagram. With this option, the arrow which is in the front (topmost layer) will be the first arrow to connect to the process, while the one that is on the last layer is the one that connects at the bottom of the process.

Z-Order for Crossing Arrows: For crossing arrow lines, the Z-Order setting can be used to determine which of the arrows runs on top of the other. Click on the arrow that is supposed to be on the top layer, and select "Bring to Front" from the context menu. Alternatively, click on the arrow underneath and choose "Send Backward" (repeat several times, if necessary, arrow will be moved backward one layer each time.

Note: Z (in addition to X- and Y-axis) is the axis orthogonal to the drawing area.

In the figure on the left the blue arrow is in front, the pink arrow is in the back. In the same diagram on the right the blue arrow is send backward, the pink arrow is now on the top layer.

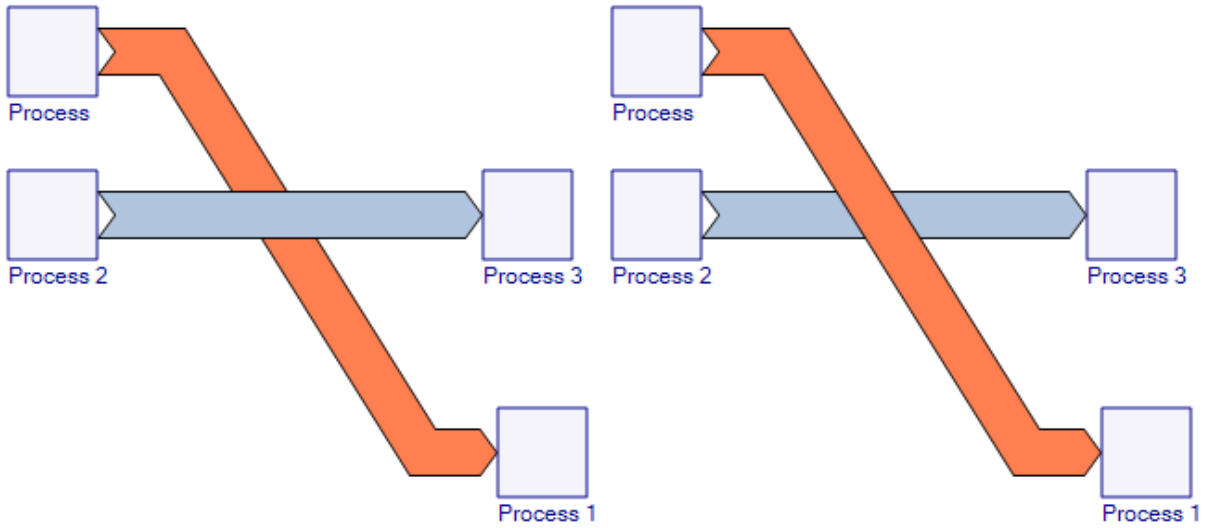


Figure 35: Z-Order determines the order of superimposition, which is important especially for crossing arrows

6 Processes

Options for Processes

Processes (or nodes) can be found at the beginning (foot) and the end (head) of each Sankey arrow. They may sometimes be turned invisible (hidden), but still they exist. Click on an arrow to mark it, and the hidden process symbol can be seen.

When marking a process symbol in the diagram, the properties pane will show the process property dialog:

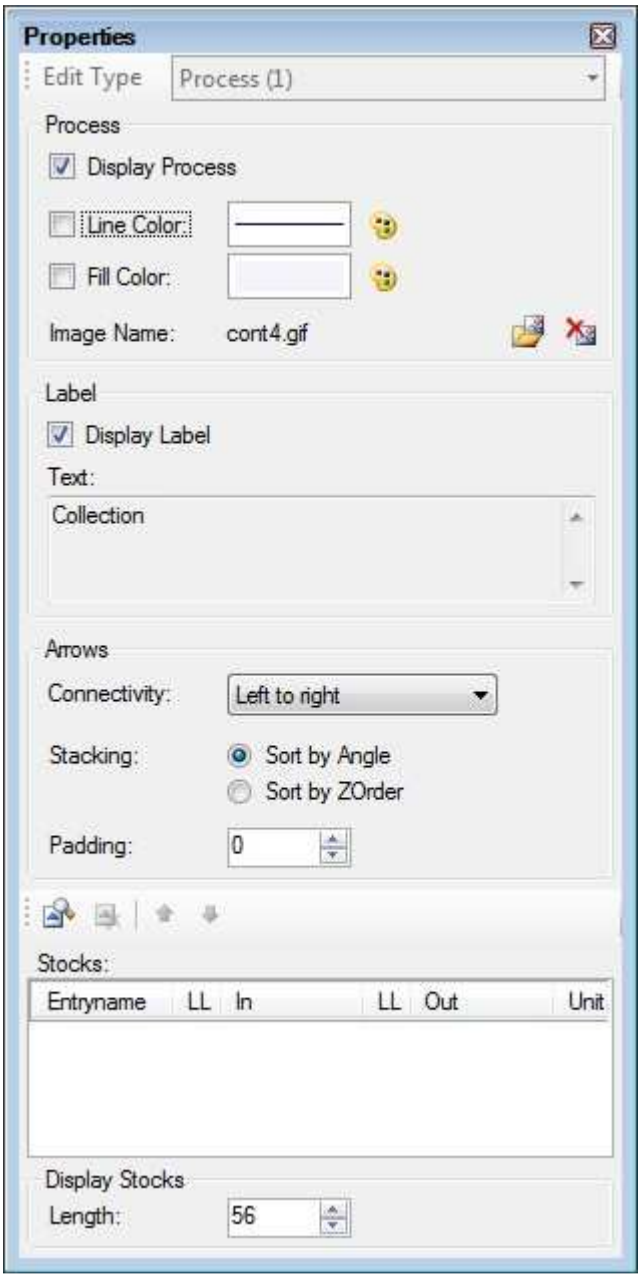


Figure 36: Process Properties

The entry in the 'Edit Type' shows the number of processes selected that will be affected by the property changes.

The option 'Display Process' allows hiding the process symbol (remove tick mark). The option 'Display Label' allows hiding the label of the process (remove tick mark).

The 'Line Color' and 'Fill Color' of the process symbol can be adapted individually. Click on the color field or the button next to it to call the color selection dialog.

The "Arrows" section in the process property dialog relates to the way that arrows are connected to the process. The connectivity and stacking settings are explained in section 2

"Stocks" are a feature of e!Sankey pro and allows to paint stubs to represent stock increase or decrease, or balance differences. Simply drag an entry from the Entries window onto a process or add the entry in the Properties Window of the process. Stocks are only shown if Connectivity is not set to 'Free'.

Hint: Use 'Set As Default' from the context menu of the file to remember the settings for the next process symbols you will be drawing in the diagram.

Using Images and Icons for Processes

The color of the process symbol border line and filling can be set individually. Instead of the default process symbol, you can also set an icon or image.

This feature is especially helpful, when you prepare your diagram for presentation, and want to create even more appealing Sankey diagrams.

Use the **Select Image** button to load a graphics file or a clipart from the clipart library included in e!Sankey.

Figure 37: Sankey diagram section using photos as overlay for process symbols

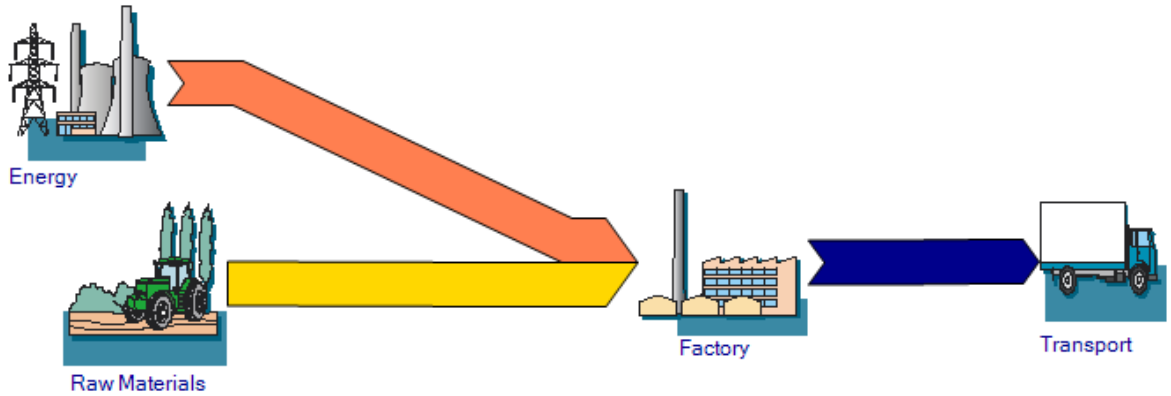


Figure 38: A sample Sankey diagram using icons from the clipart gallery

Hide Process: If you prefer not to see the process box, it is possible to hide it by unchecking the 'Display Process' option in the process property dialog. The accompanying process label can be hidden separately, using the 'Display Label' option. Most of the Sankey diagrams in the simple breakdown, the multi-phase breakout and the input-output category (see above) look better without the process

symbols. Nevertheless, to draw the arrows, and to move the arrow head around, it is required to first draw the process symbols and then hide it.

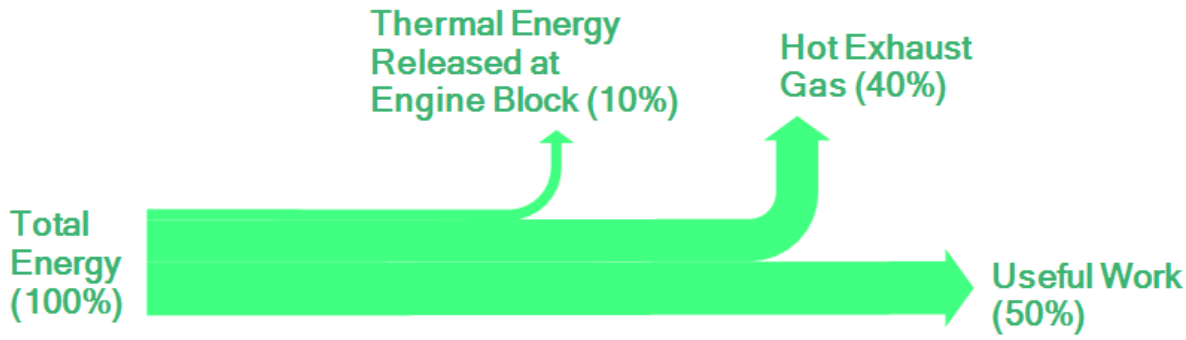


Figure 39: This simple breakdown Sankey diagram has four process symbols that are hidden

The process symbols will be shown transparently when the arrow that connects to them is marked. This allows dragging the process, if required. Process can also be hidden in the process list of the diagram properties dialog (click on empty area in the editor to bring up the Diagram Property dialog.

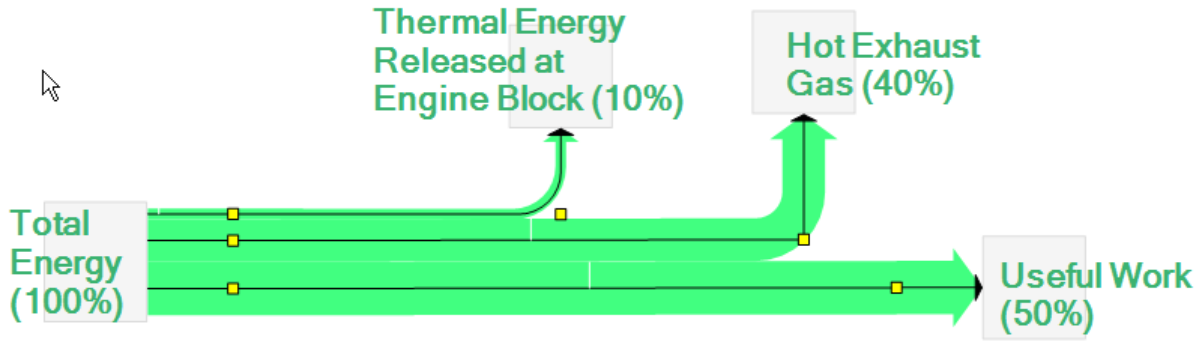


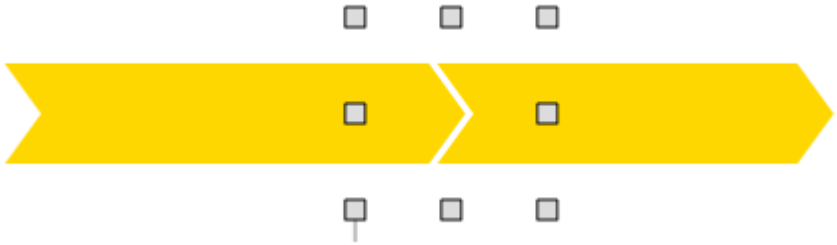
Figure 40: The above Sankey diagram, the process symbols are visible in a transparent color.

Padding for Processes

By default the arrows connect exactly at the border line of a process. This looks OK in many cases, and works especially well when you remove arrow head and tail.

With a process icon instead of the default square symbol, however, the connecting arrow sometimes seemed to be "glued" to the icon too closely. The padding option for processes in this case can be set to a positive value, increasing the distance of the arrow connect by adding an invisible padding area.

The padding value can also be negative, so that the arrow head and tail connection underruns the default border line of the process.



Figures 41: Padding at process, negative value, process itself is hidden

Changing the Process Size

When inserting a process by clicking in the drawing area, the process is shown as a square. The size can be changed by dragging the points that are shown when the process is marked. Alternatively, the process height or width can automatically be adapted depending of the arrows connected to it. To do so, choose the command 'Adapt Process Size' from the context menu of the process. In the cascading menu select 'Height to Arrow', 'Width to Arrow', or 'Height/Width to Arrow'.

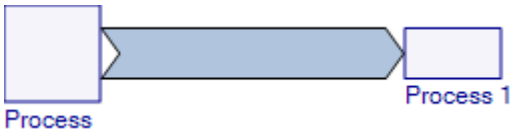


Figure 42: Default process size (‘Process’) and automatically adapted process height ('Process 1')

Additional Graphical Elements

Additional graphical elements are available to improve a Sankey diagram layout. These are: Rectangle (not the process symbol!), Rounded Rectangle, Ellipse and Line (not the Sankey arrow line!). These items are available in the 'Shapes' menu in the toolbar. Text labels can be used to add comment text in the diagram.

Furthermore images can be embedded as background.

A legend and the scale can be called via the View menu.

The rectangle, if set to transparent can be used to draw a frame around certain sections of the diagram for additional graphical structuring or grouping.

Arrows and boxes can be used to add comments in a diagram

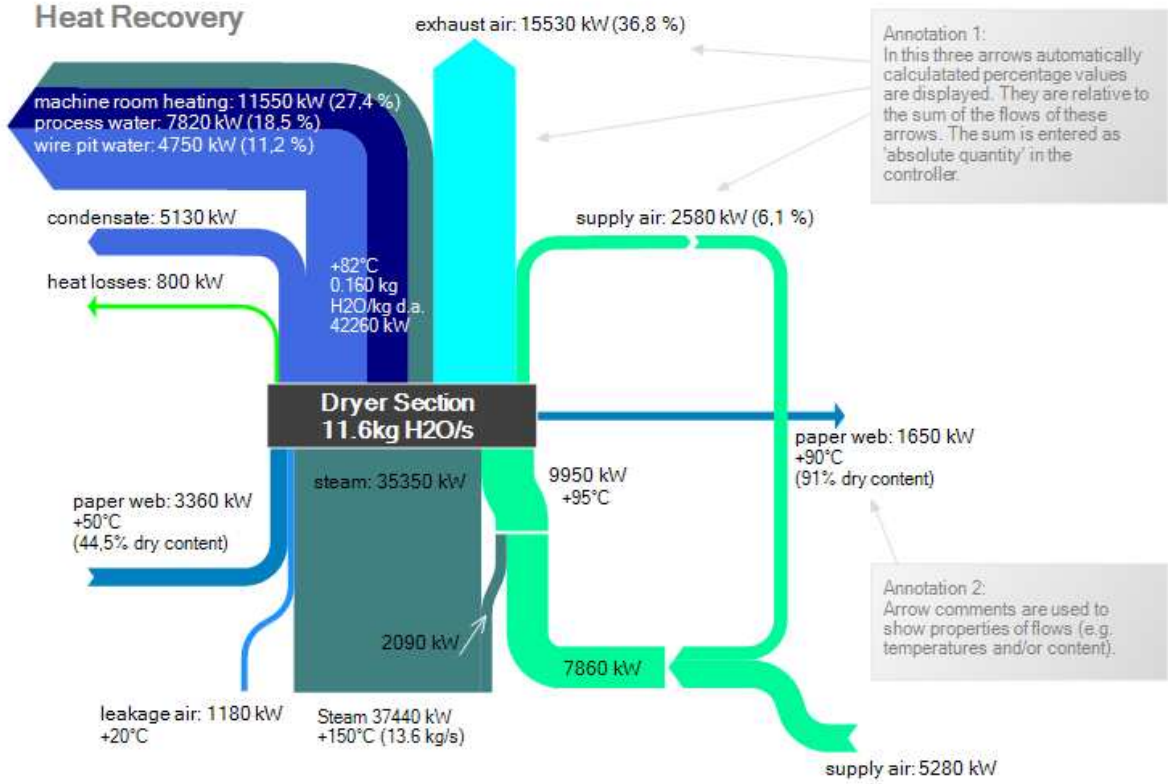

Heat Recovery
exhaust air: 15530 kW (36,8 %)
Annotation 1:
In this three arrows automatically calculatated percentage values are displayed. They are relative to the sum of the flows of these arrows. The sum is entered as 'absolute quantity' in the controller.
machine room heating: 11550 kW (27,4 %)
process water: 7820 kW (18,5 %)
wire pit water: 4750 kW (11,2 %)
condensate: 5130 kW
heat losses: 800 kW
+82°C
0.160 kg H2O/kg d.a.
42260 kW
supply air: 2580 kW (6,1 %)
Dryer Section
11.6kg H2O/s
steam: 35350 kW
9950 kW
+95°C
paper web: 1650 kW
+90°C
(91% dry content)
paper web: 3360 kW
+50°C
(44,5% dry content)
Annotation 2:
Arrow comments are used to show properties of flows (e.g. temperatures and/or content).
2090 kW
7860 kW
leakage air: 1180 kW
+20°C
Steam 37440 kW
+150°C (13.6 kg/s)
supply air: 5280 kW

Figure 43: Use of boxes with fill color and pointer arrows for additional comments

A legend can be added automatically when clicking on Show Legend in the Draw menu. The legend can be dragged to the most appropriate position and adapted using the legend property dialog. Use Delete to remove the legend again.

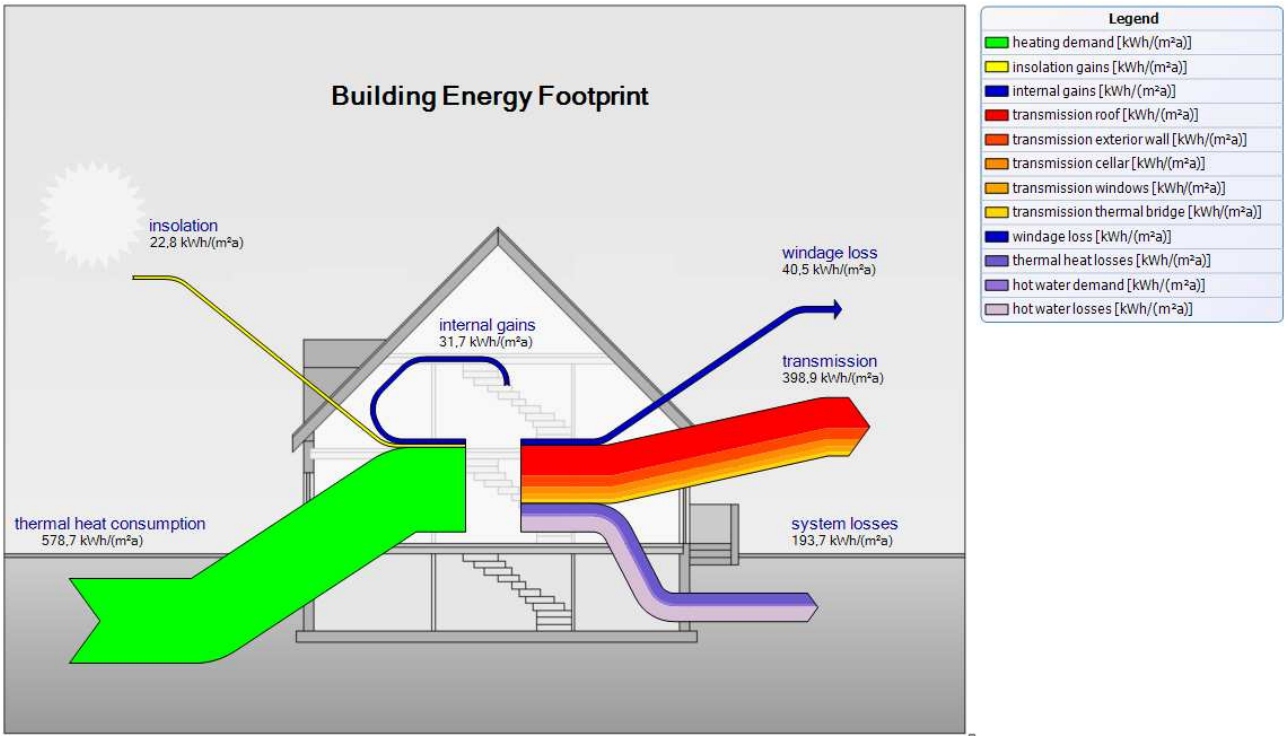


Figure 44: Legend and background image in a Sankey diagram

The image element can be used to put a logo, drawing, photo or map in the background.

Option Settings for the Whole Diagram

There are a number of option settings that can be used to give the Sankey diagram you create in e!Sankey a nice look. One option that has been already described are the arrow spikes. Settings for arrow spikes can be made in the diagram properties panel.

Open the options dialog for the diagram form the Edit menu. On the Diagram page you can change the default segment lengths of the first/last arrow segment (from the process symbol to the yellow arrow point) and the default curviness (softness of a rounded arrow bend) of arrows

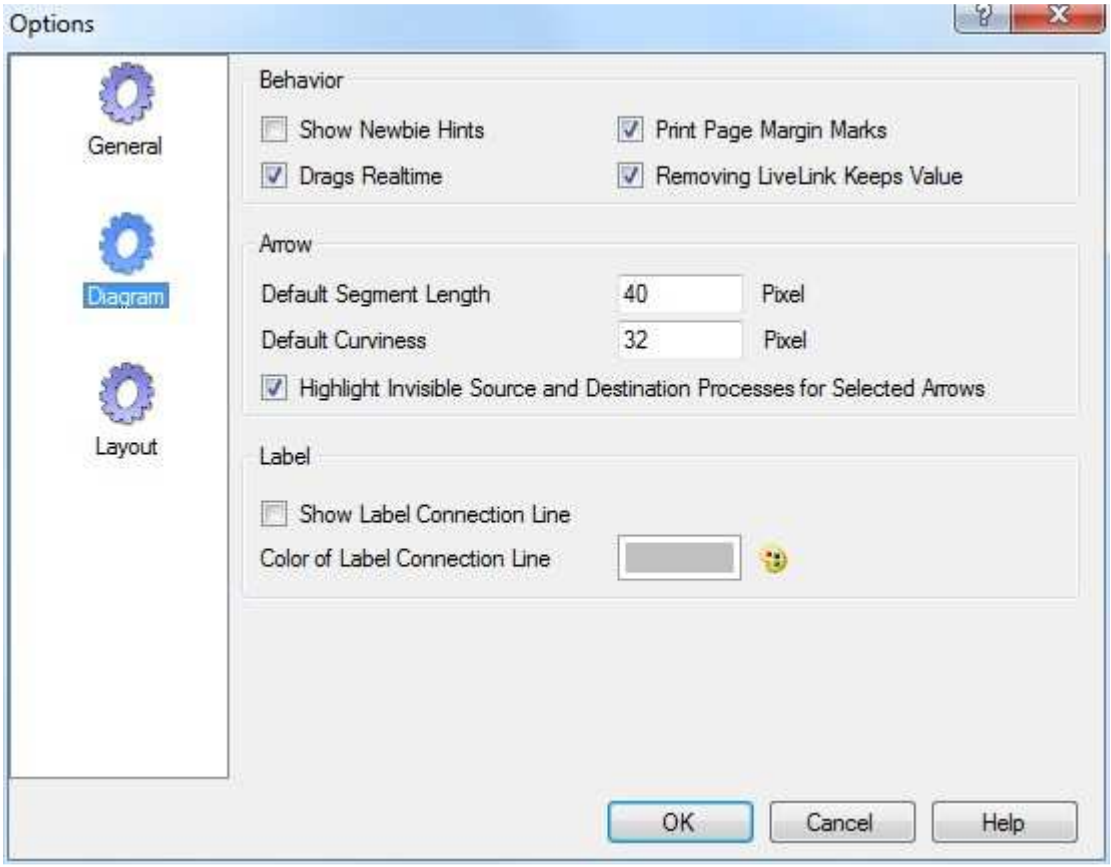


Figure 45: Options dialog

Show percentage in arrow labels: Since e!Sankey is a visualization tool and thus does not have any calculation functionality to calculate flow quantities (see comment on last page for more information), there is a feature that allows to determine the percentage of a flow within a multi flow arrow, or the percentage of its quantity in relation to the largest quantity of a flow of the same unit type in the whole diagram.

In the Flow Content Label property panel, set the 'Percentage' option to "Arrow" to show the percentage contributions of each flow in a multi flow arrow.

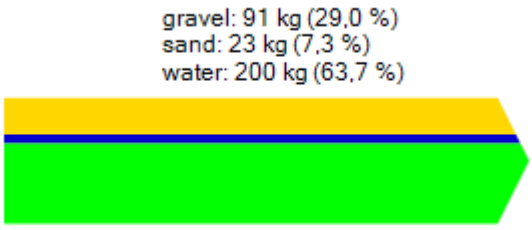


Figure 46: Percentages of the flow in a multi flow (option "Arrow")

Use the setting "Model" in the 'Percentage' option to show the percentage contributions of each flow of the same unit type in regard to the largest flow in the model.

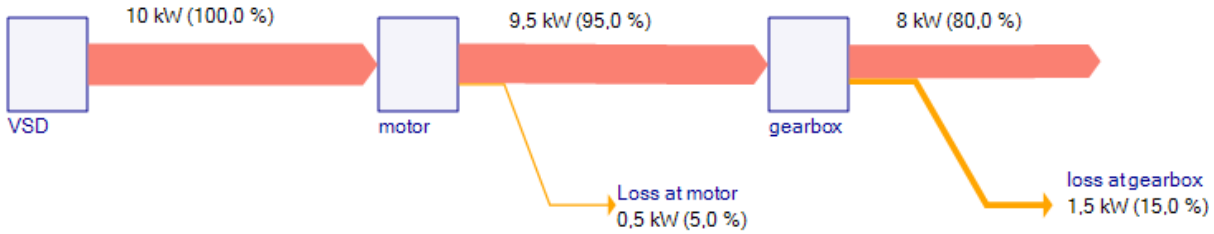


Figure 47: Percentages in the arrow labels (for "Model")

7 Entries

For each diagram, the items used as flows in the arrow have to be defined in the Entries list. This list is located at the bottom of the screen by default, but can be made floating or closed (button Show Entries panel). The Entries list can be grouped. in folders.

Create a new entry by clicking on the Add Entry button. State a name and select the unit type (for unit types see below). A color will be assigned automatically, but you can choose any other color from the color set defined for the unit type, by selecting it from the dropdown list. Any other color can be chosen by clicking on the button with the three points (see color select dialog below).

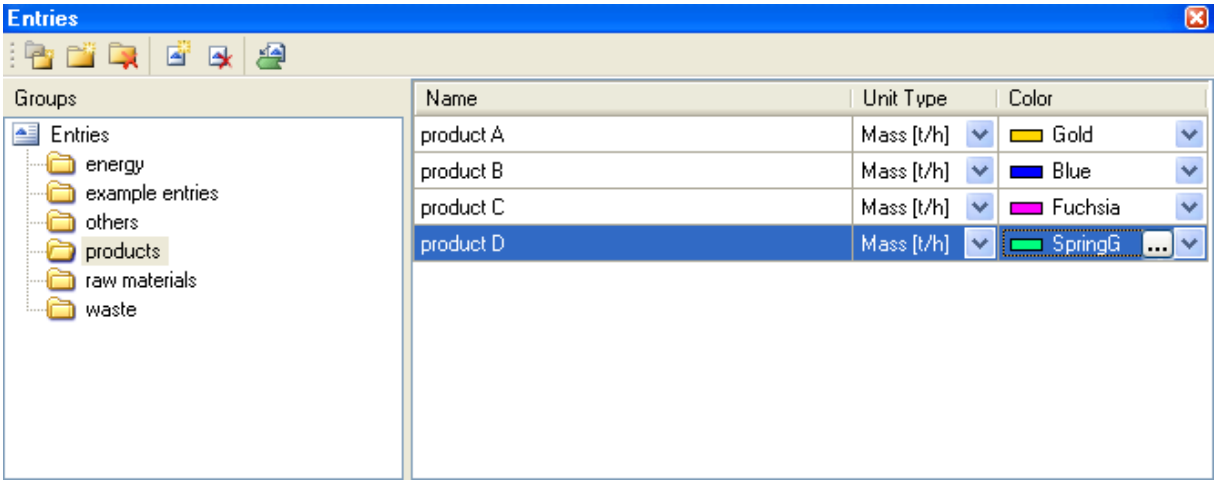


Figure 48: Entries dialog

As described above, the entries from the entries master list are added to an arrow and a quantity is stated. Adding a flow to an arrow from the Entries window can be done in three different ways:

- Drag the entry onto the arrow in the Sankey diagram
- Mark the arrow in the diagram, so that the arrow properties dialog comes to front. Then drag an entry onto the Flows table in the arrow properties dialog
- Mark the arrow in the diagram, so that the arrow properties dialog comes to front. Then select an entry in the Entries window and click on the button 'Insert Entry in Arrow'

Changing a name of a material, a unit, or a color will result in an updating of the flow everywhere in the diagram wherever it is used.

Deleting an entry from the Entries list will lead to a removal of all flows of this entry in the Sankey arrow. You will be asked to confirm this action. The command 'Delete Unused Entries' from the context menu of the Entries window can be used to remove entries that are not used as flows in the diagram.

When saving a diagram as template, the Entries list will be part of the template. Therefore you can create a model Entries list that you wish to use in different of your diagrams, and save it as a template file (.santem). New diagrams created using this template will feature the pre-defined entries list, including the colors and unit settings.

For choosing individual colors, the 'Edit Color Set' dialog will be prompted. This dialog has three tabs. On the right side the Color Set list field shows the colors defined in the

pallet for this unit type (see below). These are the colors that are presented in the dropdown box. New colors can be added to the color set

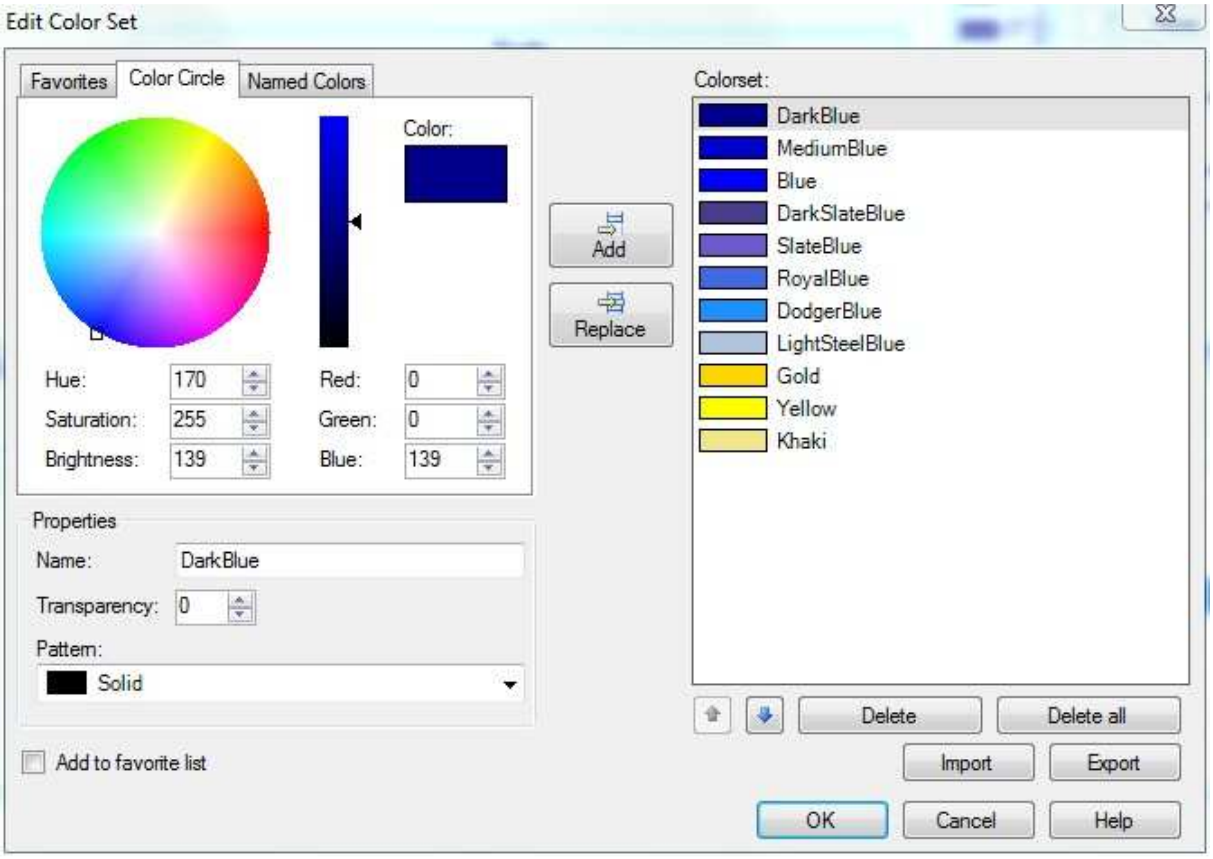


Figure 49: Color selection dialog to create individual color pallets

Transparency and a fill pattern can be chosen from the dropdown list in the Properties pane on the left.

Note: for all other color selection dialogs in e!Sankey (e.g. for fill color of a process, for line color of a graphical element, the color dialog looks similar. Instead of a predefined color set there is a list of favorite colors (Color Set tab) that will be populated, if the "Add to Color Set" check box is marked when choosing a color.

8 Unit Types

For each material in the Entries dialog, a unit type has to be selected. Unit types are administered in the Edit Unit Types dialog, accessible via the 'Edit Unit Types' button in the Controller window.

Several unit types have been prepared in the standard diagram template. Only "Mass" and "Energy" have been activated though. Additional unit types can be activated by setting a tick mark in the 'Used' column.

There is a default unit for each unit type. This unit can be edited by clicking directly in the Unit column. For example, if you prefer "Mass" not to be displayed in "kg", but rather in "tons", or "Litres/hour", or "sacks", just replace "kg". Mind that all flows based on the entry with that unit type will be updated automatically in the diagram.

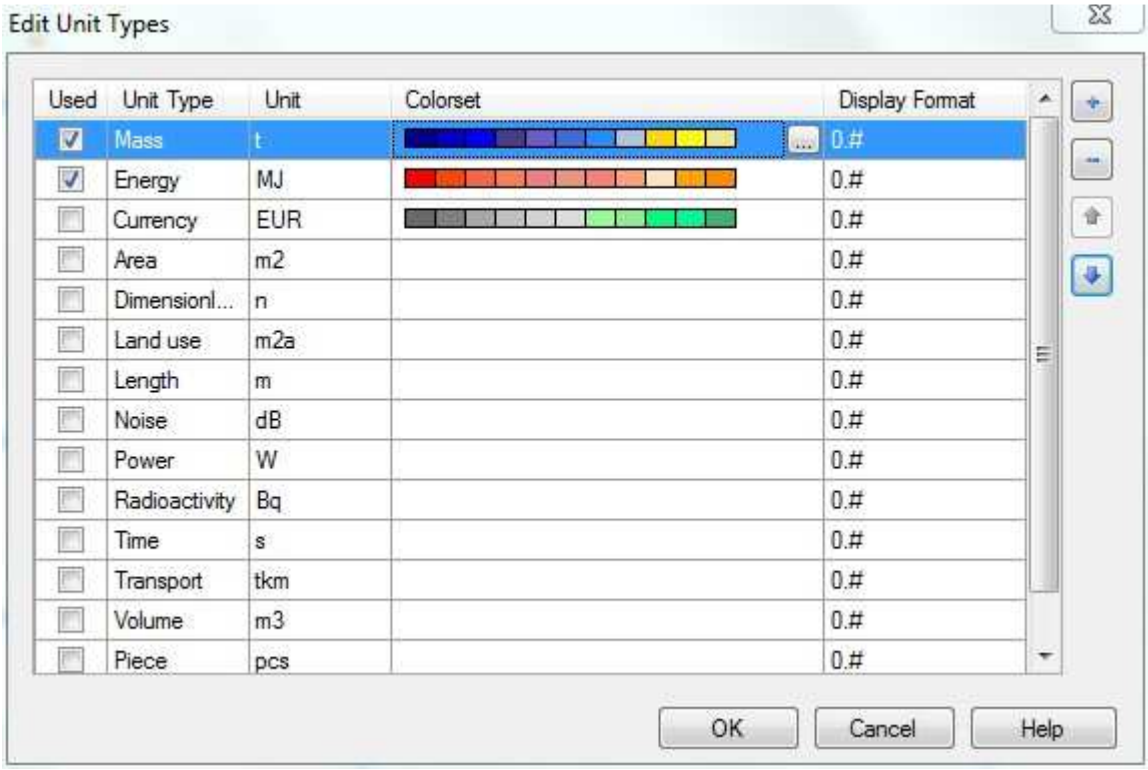


Figure 50: Edit Unit Types dialog

Additional unit types can be defined using the button 'Add a New Unit Type'. The order of the unit types can be adapted using the buttons 'Move Up' and 'Move Down'.

The color set shown for each unit type in the "Color Set" column is a suggestion and can be edited according to your wishes. Click in the cell and on the button with the three periods to open the "Edit Color Set" dialog. New colors will also be added to the color set, when the "Add to Color Set" check box is marked when choosing a color in the "Select Brush" dialog (see above).

Number Format: The Display Format column can be used to individually assign a number format to the selected unit type. All quantities are formatted to match the chosen format. By this, it is – for example – possible to define integer values for "Mass" in tons, and scientific number format for another unit type e.g. additives (in mg).

The codes that can be used in the number format are as follows:

- **0.###**
  The number is displayed with three decimal places. If it has more decimal places it will be rounded to three decimal digits. It it has less than three, the filling zeros will not be displayed.
    - The number is shown with exactly two decimal places. The value will be rounded to two decimal places, or filled with zeros if there are less. This is the common number format for currencies.
- **0,0**
  Use a comma after the first zero to display thousand separators (e.g. five million is shown as '5,000,000'). Please note that the thousand separator from the Windows Regional Settings is used.
- **0,0.00**
  The comma after the first zero is used to add thousand separators (see above). The number of decimal places is fixed to two places (see above).
- **e**
  The letter 'e' in the number format field is used to display a number in the scientific number format (standard form, exponential notation).
- **0.0;"error";<"0,1"**
  A combination of number formatting strings can be used. The one shown above is a combination of three format strings, separated by semicolons (';').
  The first section ('0.0') is applied to positive numbers (fixed one decimal place, see above).
  The second section (string "error") is used for negative values. Since negative values cannot be displayed in e!Sankey, a specific number format is not applicable. Instead of the negative number the string within the quotation marks is shown.
  The third section ('<"0,1"') can be used for null values. If, for example, rounding of very small values would turn the number to zero, the operator and the string within the quotation marks can be shown (in this example '<0,1').

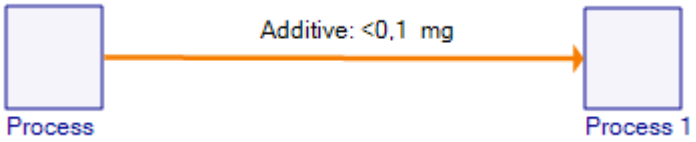


Figure 51: Example for the use of a number format for a Unit Type

Scaling: Each unit type can be scaled individually using the sliders shown on the Controller panel. The scale ration is shown at the top of slider box (e.g. 100 kg = 25px). This determines the width of the arrow with flows of the specific unit type.

Remove the tick mark in front of a scaling slider, if you don't want to display flows of this unit type in a diagram.

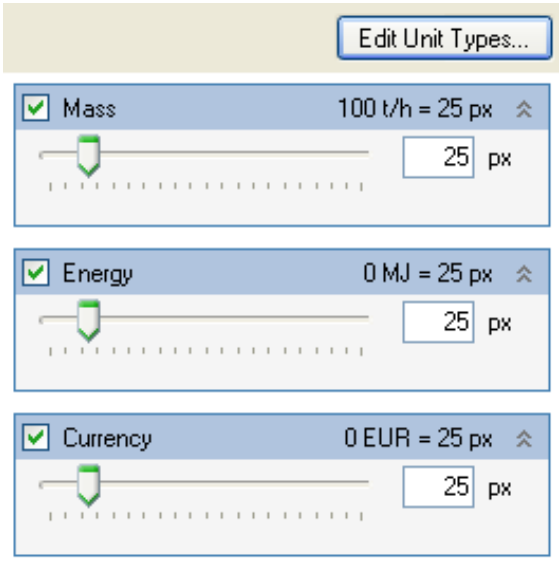


Figure 52: Sliders for scaling arrow widths per unit type

By default, the scaling is done with respect to the "Maximum flow of each unit type" in the diagram.

Alternatively you may want to scale be "Absolute quantity of each unit type". In this case an additional entry field will appear where the absolute quantity can be entered. This quantity corresponds to the scale setting of the slider given in Pixels (Px). If you set the option "Cut Off" values larger than the absolute quantity will not be scaled any more, but the arrow will maintain the width of the absolute quantity, and a transparent moirée pattern will be shown to signal that this specific flow is not to scale.

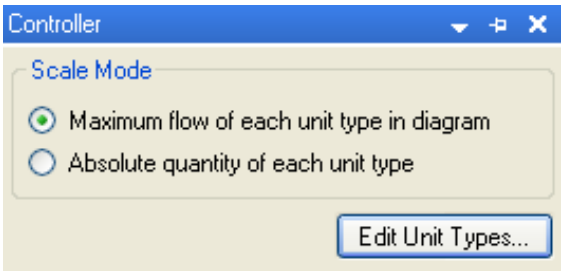


Figure 53: Scale Mode pane

Note that typically flows of different unit type are not found in the same arrow. Thus, when inserting an entry with a different unit type into an arrow, where a flow of a material with another unit type already exists, a warning will be prompted. You can actively disable that feature, by setting the "Allow different unit types in one arrow" in the diagram properties dialog.

9 Templates

e!Sankey allows to save diagrams as template files. Template files can serve as models for creating new diagrams in the same styles. When saving a diagram as a template file, the following items will be included:

- Entries
- Unit Types (with their color pallets)
- Network Elements settings (see Set As Default command)
- Option settings

When you create new diagram using a stored template, all of the above will be available.

To store a diagram file as template file, use the 'Save As…' command from the File menu. In the file save dialog choose 'e!Sankey Template (.santem)' from the file type dropdown list. A dialog will be prompted, that allows you to enter a short 1-line description of the template. The template can be identified with this description in on the start page.

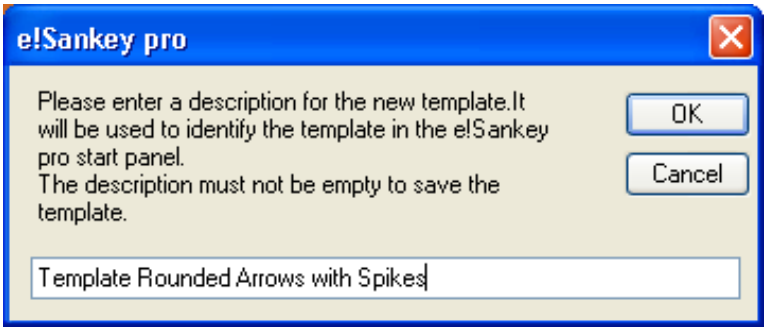

e!Sankey pro
Please enter a description for the new template.It will be used to identify the template in the e!Sankey pro start panel.
The description must not be empty to save the template.
OK
Cancel
Template Rounded Arrows with Spikes

Figure 54: Description for template file

To create a new file using a specific template, either click on the entry in the Templates list on the start page, or choose the template by its description from the cascading menu of the 'New' command in the File menu.

The template files are located in the "Templates" subdirectory of the e!Sankey installation. If you receive template files from someone else, you can just copy them into that folder, and they will appear as a template to choose from in the list.

10 LiveLink to Excel (e!Sankey pro only)

With this feature a "live" connection from one or more Excel spreadsheets to an e!Sankey diagram can be established. When changes are made in the spreadsheets connected to the e!Sankey diagram file, it can be updated (automatically or manually), so that the arrow widths and the text labels in the diagram reflect the new values.

Excel Live Links to Excel can only be created for existing diagram elements. Drawing new diagram elements with this feature is not possible. The Excel LiveLink works for the following versions of Microsoft Excel: Excel XP (2002), Excel 2003, Excel 2007 and Excel 2010.

Excel Live Link for Numeric Values: The Excel LiveLink dynamically links the quantity value for a flow in an existing diagram file in e!Sankey with a cell in an Excel spreadsheet. When the user changes the value in the cell of the Excel sheet, the value in the Sankey diagram will be updated automatically and the arrow is redrawn accordingly, so that its magnitude represents the new value.

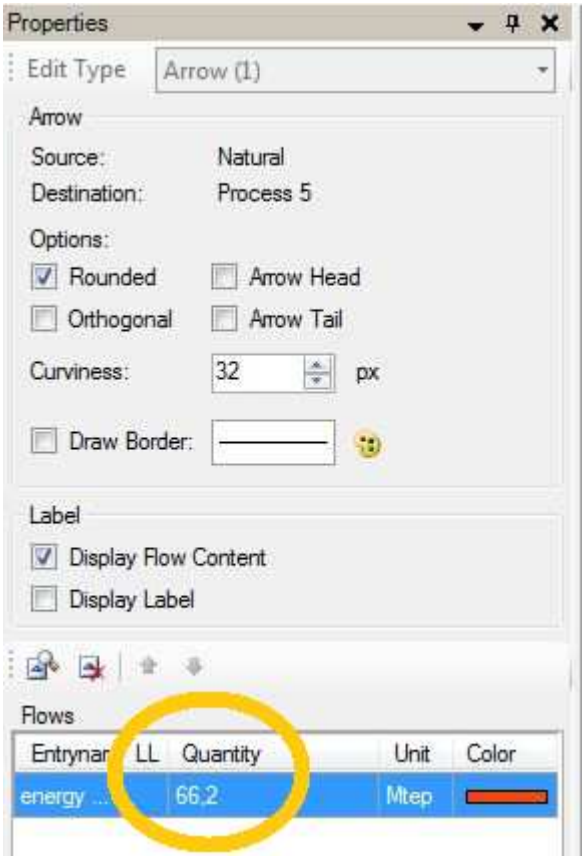


Figure 55: Manually specified flow, no LiveLink has been created yet

A LiveLink is created by copying a cell value in Excel ('Ctrl-C') and pasting it ('Ctrl-V') in the "Quantity" field in the Arrow properties panel. To have this Properties panel visible, the arrow must be selected, before the cell content is pasted. A LiveLink reference to the address of the cell in the spreadsheet will be created. An icon in the column is shown, to indicate the status of the LiveLink.

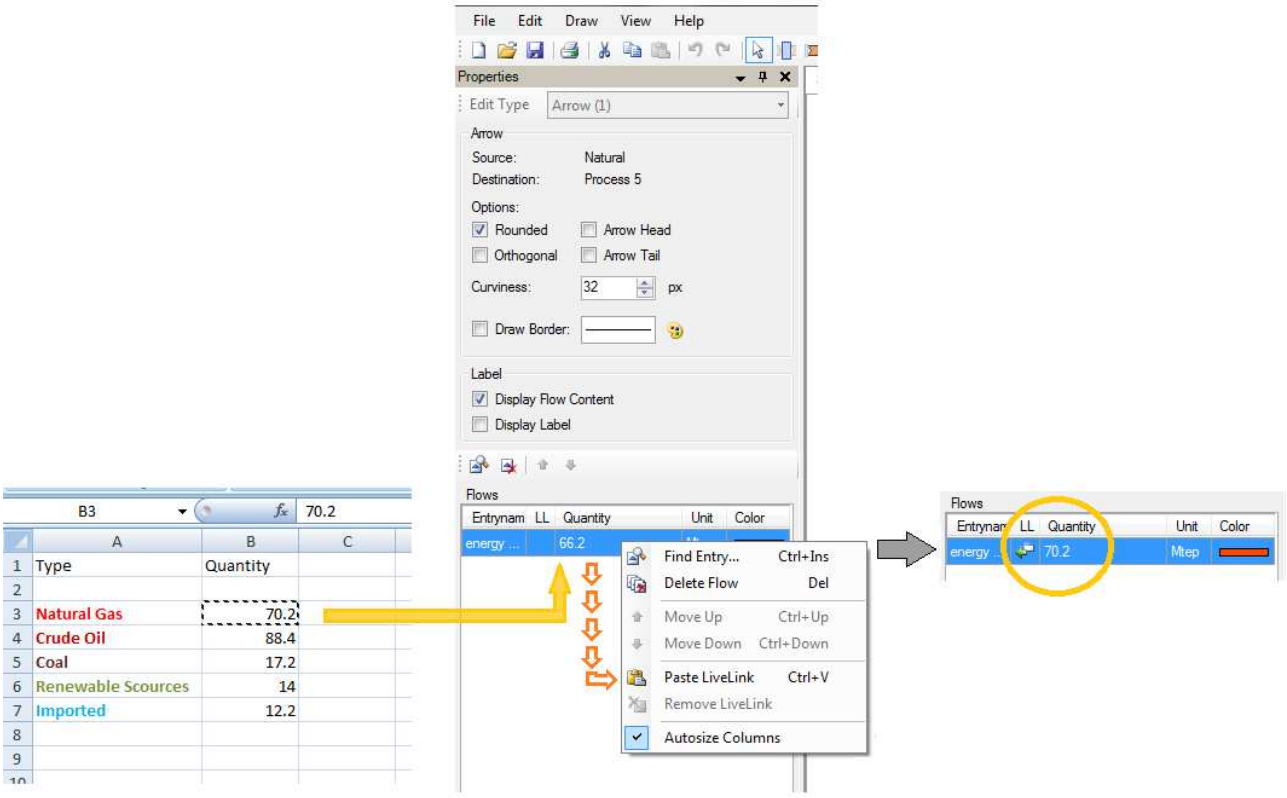


Figure 56: Copy the cell value in Excel. Select the arrow in e!Sankey. On the left side of the screen, paste into the area below "Flows".

Note that there can be multiple LiveLinks from one or more Excel worksheet(s) in one or more Excel file(s) into one e!Sankey diagram. The Excel files can also be located on a shared network drive so that other users can update the values.

Note that the LiveLink references to the value of the cell, so that the cell in Excel may also contain a formula or a currency sign (e.g. "1.000 $"). In previous versions of e!Sankey the cell could only contain a number, since the LiveLink was interpreted as a text string.

Update of LiveLinks: When a Sankey diagram file that contains LiveLinks is opened, the user is prompted with a dialog box and asked whether LiveLinks should be updated.

LiveLinks can also be updated at any time using the commend 'Update LiveLinks' (menu 'Edit' > command 'Update LiveLinks…') or by clicking on the 'Update' button in the Edit LiveLinks dialog . The update works even if the Excel file is closed.

In case you wish to view changes made in Excel directly in the Sankey diagram, you can keep the Excel file open at the same time. In this case make sure you have updated the LiveLinks as described above at least one time. All changes of values in the cells referenced with a LiveLink will cause the Sankey diagram to update immediately.

Editing LiveLinks: An overview of all LiveLinks can be seen in the 'Edit LiveLinks' dialog (menu 'Edit' > command 'LiveLinks…'). Note that this command in the Edit menu is only active after the first LiveLink has been set, otherwise it appears greyed (inactive).

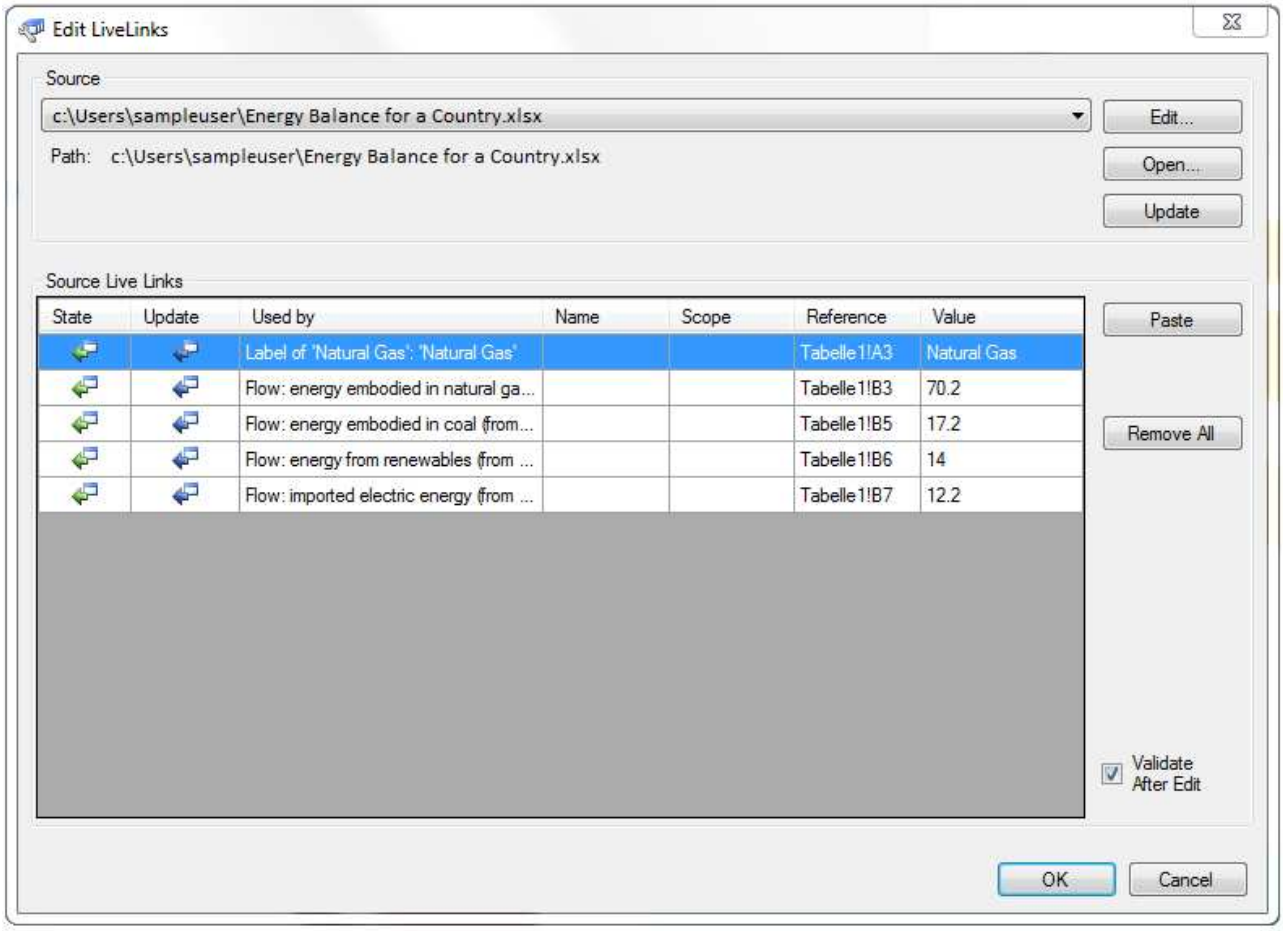


Figure 57: Edit LiveLinks dialog shows the Excel files and cells to which LiveLinks have been created

The name of the source Excel file is shown in a selection list in the panel 'Source' at the top. The path to the location of the file is shown below the list. To modify the source Excel file click on the button 'Edit…'. To open the connected Excel file click on 'Open…'.

For the Excel file selected in the dropdown list 'Source' above, all existing LiveLinks are shown in the 'Source LiveLinks' table below.

Each LiveLink entry can also be directly edited in this table: A LiveLink reference can be pasted directly in one selected line (as an alternative to pasting it into the flow table in the Properties dialog of an arrow as described above).

In case the LiveLink is to direct cell address, this address (e.g. "Table1!A15") is shown in the column 'Reference'. Should the reference be into a named cell (see below), this is shown in the columns 'Name' and 'Scope' (i.e. the name of the worksheet).

Excel LiveLink for Text String: Additionally to the LiveLink for numerical values, text strings from Excel sheets can also be linked to text elements in the e!Sankey diagram file.

This can be done for Text Labels, Process Labels and Arrow Comment Labels. (Note: Arrow Labels are created automatically from the entry name, the quantity, and the unit. They are not directly editable, thus cannot be updated via an Excel LiveLink.)

A LiveLink for a text string is created by copying a cell value in Excel ('Ctrl-C') and pasting it in the text label, process label or arrow comment field using the Paste Live Link button below the text field. The LiveLink is shown by the active LiveLink icon.

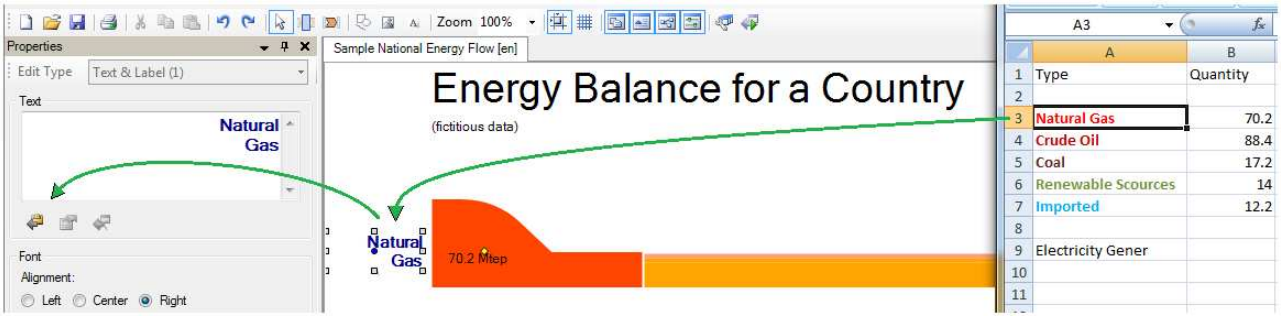


Figure 58: Copy the text from a cell in Excel. Click the existing text label in e!Sankey. In the Properties dialog click on the button Paste LiveLink.

Note: Pasting the content of the clipboard with 'Ctrl-V' will just paste the content as normal text, but will not set the Live Link!

To remove a live link connection, click on the button 'Remove LiveLink' below the text entry field of a text label, process label or arrow comment.

To edit a live link for a text string, click on the button 'Edit LiveLink' below the text entry field.

Using Named Cell Areas in Excel to Maintain LiveLinks to Cells: When a LiveLink is created to a cell in an Excel sheet, the reference is by default made to the cell ID (e.g. "C1"). However, if the spreadsheet layout is changed the location of the cell with the value that is linked to the diagram in e!Sankey might be shifted. This happens, for example, when columns or lines are inserted.

In order to maintain the LiveLinks even when the location of the original cell, thus its cell ID, changes, it is necessary to work with named cells. Before you create the LiveLink as described above, name the cell (in Excel 2003: Menu Insert > Names > Define, in Excel 2007: Menu Formulas > Define Names or context menu of selected cell > Name a Range > New Name). When a Live Link is created, it will use the name of the cell instead of the direct cell address ID. The named cell can be located anywhere in the Excel sheet, even when it is moved. When the value in the named cell is updated, the LiveLink will still work even though it might have a different location.

11 Exporting and Printing

Save a Sankey diagram file using the 'Save As' command in the file menu, A e!Sankey diagram file has the file extension '.sankey'.

To create an image file from the Sankey diagram you created in e!Sankey, choose the 'Export…' command from the File menu, and select a file type. The following file types are available: PNG, JPG, GIF, BMP, EMF.

Note that the graphics file created is typically limited directly by the network elements, i.e. does not have a white margin area around it.
It is recommended to select a large Zoom factor (e.g. 400%) before exporting the diagram to a file, and then reduce the size of the image file, in order to obtain the best quality (e.g. in a printout).

To directly copy a Sankey diagram, select all elements (either by pulling a frame around it, or by using CTRL-A), then copy it (with CRTL-C or with the Copy command from the Edit menu). Switch to the other application (Word, Power Point, etc.) and paste the content of the clipboard.

Printing: The diagram can be printed using 'Print…' from the File menu. A print preview will always be shown. It allows adjusting of the zoom and page setup. There is an option for hiding page margins on the printout in the Options dialog on the Diagram page ("Print Page Margin Marks").

12 Further Hints

Change the language setting of the user interface of e!Sankey in the Options dialog. A restarting is required for the language change to take effect. Currently the languages English, German, French, Spanish and Portuguese are supported.

The 'Version' panel on the start page will show you, if the license is up-to-date or if an update version has been made available. This check for updates can be disabled in the Options dialog. If it is disabled use "Check for Updates…' from the Help menu. An internet connection on port 80 is required. If your corporate policy prohibits this, please see the News announcements on http://www.e-sankey.com/ to find out if there is a new version. Updates within the same version step (e!Sankey 3.x) are free-of-charge. Visit the e!Sankey forum at http://www.e-sankey.com/smf/index.php to read hints, get support and discuss with other e!Sankey users.

The support e-mail address is support@e-sankey.com

Command Line Version and Integration of Sankey Diagrams

A command line version of e!Sankey is available on request. It allows for automatic updates of Sankey diagrams from a data source. Please inquire about licenses at sales@e-sankey.com should you be interested in the command line version.

Integration into other application is possible. Please contact development@ifu.com should you be interested in a customized solution.

e!Sankey – show the flow. ← → Umberto – know the flow.

The software e!Sankey for the visualization of material and energy flows is a side product of the development of the material and energy flow modeling software Umberto. While e!Sankey requires all flows to be known, and can only display these flows in an graphically appealing diagram, it's bigger brother 'Umberto' is a fully fledged modeling tool. It is used to determine material and energy flows in a process system using process specifications and powerful calculation algorithms. It also allows calculating the costs associated with material and energy flows in the production system, and the environmental impacts. Sankey diagrams are an alternative display option for the modeling results.

Read more about Umberto on http://www.umberto.de

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